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CONTENTS

Editorial—
Announcement 95
Waterproofing of Subways 95
Which? 95
Index to Photographs 97
Officers of the American Engineering and Maintenance of Way Assn. 98
Representative Railway Engineering Officials of America 99
Representative Railway Signal Officials of America 122
Officers of the Railway Appliances Assn 133
Members of the Executive Committee of the Railway Appliances Assn. 134
Waterproofing of Subways 135
What Comprises Good Insulation 140
The New C. & N. W. Terminal at Chicago 141
The Signal Department 147
Stated Meeting of the Railway Signal Assn 147
Railway Signal Standards No. 16. The Erie 147
Third Annual Report of the Block Signal and Train Control Board (continued) 148
The Maintenance of Way Department 155
Rail Braces and Slide Plates 155
Dial and Transit Clips 155
Construction Cost in Siberia 155
Ancient Building Construction in India 157
Railway Construction 157
Personals 159
Among the Manufacturers 160
An Efficient Anti-Rail Creeper 160
Metal Stock Guards 160
Track Laying on the Crosbyton South Plains Ry 161
An Automatic Tie Adzing and Boring Machine 161
Improved Railway Motor Cars 163
Vitrified Clay Conduit for Signal Work 163
Industrial Notes 165
Recent Engineering and Maintenance of Way Patents 166

Announcement.

THE PHOTOGRAPHS OF railway engineering officials reproduced in this issue have been collected during the past few years, each year the collection becoming more complete. This is probably the last time the entire set will appear in connection with any single issue of Railway Engineering and Maintenance of Way. This being the case, it is probable that a large number of those interested will wish to keep the March issue for reference in years to come on account of this album feature. In order that this may be done, the publishers have decided to make up a large number of bound volumes, to consist of a copy each of the March and April issues. The books will be made as durable as possible with cloth and board covers, and aside from the interest lent by the photograph feature, the complete report of the March convention contained in the April issue will make the books a valuable library acquisition. The reproductions of the photographs are kept on file and will be used individually to illustrate personal items in the future.

Waterproofing of Subways.

THE PREDOMINANT NOTE in an article on the subject of waterproofing railway subways published on another page seems to be that the waterproofing of subways requires constant supervision, and that careful attention must be given to the smallest details, if the subway is to be really waterproofed. It is an established fact that a great many subways are far from being waterproof. Undoubtedly a great many of these failures are due to imperfect methods. It is equally certain that many failures are due to poor workmanship and carelessness in following designs or methods.

Here is a clear instance of false economy which frequently occurs in railway construction. Higher priced labor, higher priced and ample supervision would in a great many instances result in a very appreciable final saving, although initial cost might be increased. However, it does not follow that the first cost will be noticeably greater. If higher wages are paid for labor engaged in those kinds of work which require special care, better and more efficient labor will be available, attracted by larger wages. If discrimination is then used in choosing men, more intelligent men may be had; thus we will get not only increased individual efficiency, but increased gang-efficiency, owing to the fact that intelligent men can be more thoroughly organized than those of lesser intelligence, and organization is of most vital importance in the handling of labor.

Which?

THE QUESTIONS OF railway rates, regulation, policy and management are usually considered foreign to the engineering and maintenance of way departments. For this reason it may have appeared strange to some of our readers that we should have, during the past few months, devoted so much editorial space to such matters. We therefore wish to show here our reasons for so doing, chief among which is that we are convinced that anything that bears on the welfare of the roads as a whole is of vital importance to every

employee, no matter what may be his peculiar occupation. The railroads of the United States are now passing through a crisis, the outcome of which is by no means certain. It is within the power of the employees themselves to decide what this outcome shall be, and on their decision rests not only the future of the railroads—we might almost say their life or death—but the condition of the employes themselves. For, if private enterprise shall fail and be superseded by government ownership or operation, the status of the employee himself will be materially altered. The employees of the railroads hold the balance of political power in this country, and could they but be brought to realize this fact and act accordingly there would be a radical change of heart on the part of many "statesmen" now pleasantly occupied in the game of railroad-baiting as a shield to other activities.

The crux of the whole matter is this: shall the railroads be allowed to charge such rates that they may earn a fair return on the investment? Political buncombe has sought to cloud the issue with much talk on physical valuation, value of service vs. cost of service, efficiency of management and other high sounding terms, designed to confuse the mind and befog reason. We shall, therefore, take up in order and discuss the points at issue in as clear and brief a manner as may be, in order that a correct understanding may be had of the matter.

* * *

We often hear it said that it is in accordance with rulings of the Supreme Court that common carriers are entitled only to a fair return. This is a perversion of the facts. What has been held repeatedly is that a fair return is the least that they may be permitted to earn. Such a decision is in accordance with common sense, which cannot be said of the usual interpretation.

The matter of a fair return involves several considerations not usually taken into account. This was brought out by President Ripley of the Santa Fe not long ago when he said that certain improvements should be paid for out of earnings and others from new capital. The point is this: there are many facilities demanded of right by the public conductive to better service which of themselves yield no return on the investment. Conspicuous examples are the costly and artistic passenger stations in certain large cities. The majority of these cost many times the price of buildings that would meet all the requirements of the service, but would not tickle the vanity of the community served. Now is it fair to charge such excesses to capital account? None of these buildings is of permanent value; they must all be destroyed and rebuilt repeatedly as has been done in the case of the Grand Central station in New York. If bonds are issued against such facilities a road must be prepared forever to pay interest on an investment which after a few years will have ceased to exist. This perpetual interest must be paid out of earnings and at the usual rate this will equal the capital in from twenty to thirty years. Therefore the road must earn enough to build one of these stations every twenty-five years, say, but meanwhile it has become obsolete and a new one has taken its place. It requires no great flight of the imagination to see the ultimate result. What should be done is to charge such improvements to operating expenses; in other words, pay for them out of earnings and in so doing eliminate the perpetual interest charge. Temporarily this would call for an increase in rates, but in end, a very short time, would constitute true economy and, moreover, the public should be expected to pay for improvements for its sole benefit. It would tend to make railroad securities more salable, thus opening a means to provide money sorely needed for remunerative improvements, such as block signals, heavier rails, new ballast, etc.

Should rates bear any relation to the physical value of a road? Most assuredly not, for the value of any plant is represented not alone by its replacement value, but by its value as a going concern, including good will, credit, franchises, etc., and for further reasons which will appear later.

Many misinformed journals, including most of the prominent daily newspapers, and some public officials, maintain that rates should be based on the cost of service. Now within certain small limits the cost of transporting a carload of ore does not differ for a given distance from that of a carload of cut glass, yet is there anyone who will truthfully say that each should bear the same rate? And on a rate which will cause a car of cut glass to move from Chicago to San Francisco, will anyone be foolish enough to maintain that any shipper could afford to ship ore the same distance? Or, will anyone maintain that a railroad could afford to carry cut glass at the rate charged for ore? There are many commodities that must of necessity to move at all bear a rate which is less than the cost of service, and the loss must be made up in part by rates on other high grade articles, on many of which any rate would bear on infinitesimal relation to the value of the article; gold is a good example. Another factor enters here to offset in part the loss. If traffic is dense in one direction and many empty cars would consequently move in the opposite direction, any lading for which can be charged a rate which will contribute in some degree towards the payment of fixed charges will represent so much gain. This is one reason why it is possible to move low grade freight at the rates which prevail, and why rates can bear no relation to the value of the property. Another factor in rate making which is little understood is the so-called competition of markets. Pacific Coast fruit growers, to cite one example, must sell their product in Chicago in competition with the fruit grown in Michigan. If they are to make a profit, and if they do not, they will not ship at all, they must command a rate considerably less per ton mile than the Michigan fruit growers. Hence, rates must be based on value of service and what the traffic will bear, meaning, thereby, such a rate as will cause it to move profitably to the shipper. This is another reason why rates can bear no relation to the value of the property.

Traffic men throughout the country have been lampooned and abused because they have stated in court and before the Interstate Commerce Commission that there was no scientific basis for rate making; that no rate could be defended of itself on its own merits. In view of the principles enumerated, will anyone deny that they are right?

Mr. Brandies, a well meaning lawyer of national reputation, and all the more dangerous in consequence, has said

that the railroads lose by inefficient management $1,000,000 per day and the press of the country stands aghast! Consider one moment. Suppose this is so, but suppose also that it will cost $800,000 per day to reclaim the waste. What, in the words of a recent writer, was the loss, and in view of the condition of the money market, is it worth correcting, considering it as split up among all the roads?

Now to return to the original question: are the roads to be permitted to earn a fair return? If not, there is but one outcome, government ownership. Shall we have this or shall we continue to provide a broad field for private and personal enterprise and ambition in no way inimical to the public welfare? It is up to the railroad employes by helping to form public opinion and through the ballot to say. Which?

Index to Portraits

Adams, E. L. 127
Allen, C. F. 101
Anthony, C. C. 126
Ames, Azel 134
Arey, R. J. 114
Ashton, Wm. 104
Artman, H. R. 115
Atwood, J. A. 104
Atwood, Wm. G. 103

Baker, N. E. 125
Balliet, H. S. 123
Bainbridge, F. H. 113
Baldwin, A. S. 101
Barnes, O. F. 111
Bartholome, C. L. 132
Bauman, F. J. 131
Beaumont, Jos. 122
Beck, G. E. 132
Beckett, F. T. 109
Belknap, R. E. 133
Bisbee, F. M. 110
Black, E. A. 131
Blaiklock, M. S. 106
Bland, J. C. 110
Blunt, John E. 102
Boland, John A. 110
Boyce, Geo. 125
Bradley, Wm. L. 113
Bremner, Geo. H. 101
Broodbent, J. H. 129
Brook, Geo. D. 113
Brown, A. V. 107
Brown, P. C. 117
Brown, Wm. H. 119
Browne, J. S. 112
Browne, W. L. 103
Bucholz, C. W. 104
Burgdorf, M. J. 105
Burgess, G. 131
Burgess, G. H. 103
Burke, James 107
Burpee, T. C. 108
Burrell, F. L. 118
Bush, Wm. H. 116
Byers, M. L. 105

Cain, P. 108
Carpenter, A. W. 111
Carpenter, L. E. 130
Carrol, Phil 111
Carter, E. C. 102
Carter, E. M. 117
Cartlidge, C. H. 101
Chamberlain, O. P. 99
Chamberlin, C. H. 109
Charles, T. N. 128
Chick, J. S. 102
Christofferson, C. A. 122
Churchill, Chas. S. 98
Clausen, L. R. 124
Colpitts, W. W. 103
Colwell, A. J. 118
Congdon, J. P. 108
Connell, C. H. N. 106
Cooper, Frank W. 111
Cowan, H. W. 105
Craig, John J. 129
Crawford, Owen 116
Cunningham, A. O. 99
Cushing, E. B. 99
Cushing, W. C. 98

Darling, W. L. 119
Darrow, F. T. 106
Denison, F. W. 117
Denney, C. E. 126
Didier, Paul 115
Dodd, E. B. 129
Dougherty, C. 106
Draper, F. O. 117
Dryden, W. L. 131
Dunham, C. A. 123
Durham, E. M. 116

Eck, W. J. 125
Elliot, R. O. 121
Elliot, W. H. 124
Ellis, G. E. 126
Ericson, E. G. 116
Evans, John D. 100
Everett, E. A. 132

Fernstrom, H. 104
Finley, Wm. H. 108
Fisher, Sam'l B. 100
Foale, H. J. 123
Fox, A. L. 103
Frame, J. T. 107
Fritch, E. H. 98
Fritch, L. C. 98

Gaffin, W. W. 111
Gagel, Edw. 105
Gatewood, R. T. 113
Gatlin, H. 107
Gaunt, J. M. 118
Gilman, C. R. 132
Grafton, W. McC. 122
Gray, Edw. 106
Greiner, J. E. 101
Griffith, A. H. 116

Hadwen, L. D. 119
Hale, H. E. 110
Hanna, E. E. 112
Hanna, John V. 100
Hanson, E. 129
Harmsted, J. L. 130
Harrison, W. A. 127
Hart, E. E. 99
Harwood, Geo. A. 106
Haskell, E. A. 111
Hastings, W. R. 126
Hatt, W. K. 101
Helland, Hans 117
Hemphill, F. J. 130
Hendricks, V. K. 111
Herrold, Geo. H. 106
Hestle, J. S. 116
Higgins, W. H. 131
Himes, A. B. 131
Hitchcock, Chas. H. 116
Holtsberg, D. C. 111
Hovey, M. H. 125
Howard, Jas. K. 119
Hoyt, C. B. 101
Hulsizer, G. W. 124
Hunt, Frank Stuart 114

Ibsen, H. 110
Irwin, J. C. 101
Isbester, G. C. 134

Jacoby, H. S. 99
Jeans, F. T. 118
Jenkins, J. B. 115
Johnson, Chas. W. 104
Johnson, Roy 109
Johnson, R. C. 132
Johnson, Thos. H. 102
Jones, J. C. 128
Judd, C. B. 103

Katte, E. B. 105
Keller, S. B. 129
Kelley, H. G. 98
Kelloway, C. J. 122
Kelly, A. J. 128
Kenly, R. G. 106
Killam, A. E. 120
Kinch, L. E. 130
King, A. H. 118
Kingman, L. 117
Kinsman, A. M. 104
Kittredge, G. W. 100
Knickerbocker, C. E. 99
Koran, J. D. 112
Kruttschnitt, Julius 102

Lahmer, J. A. 115
Lakin, F. D. 113
Lapham, Chas. 114
Latimer, J. B. 124
Lawrence, C. K. 102
Layfield, E. N. 103
Layng, F. R. 109
Le Boutillier, G. 114
Lemly, C. McC. 115
Lemond, J. S. 119
Leonard, H. R. 110
Lewis, H. W. 125
Lichty, C. A. 121
Lindsay, C. E. 113
Lomas, H. F. 127
Longhren, A. J. 127
Loweth, C. F. 99
Lutz, T. E. 132

McDonald, B. M. 119
McDonald, Hunter 99
McKee, H. C. 120
McKee, R. J. 120
McKeen, A. H. 125
McKinnan, John 134
McLellan, C. T. 118
McNab, Wm. 98
McPherson, Duncan 108
MacDougald, G. N. 124
MacFarland, G. E. 128
Mallett, Samuel 128
Manuel, W. N. 122
Martin, J. T. 118
Meade, J. M. 109
Miskelly, S. G. 127
Mitchell, W. M. 105
Monsarrat, C. N. 111
Montzheimer, Arthur 104
Moore, C. H. 107
Moore, F. N. 115
Morris, Robt. L. 112
Morrison, C. H. 125
Morrison, Wm. 126
Morse, W. L. 114
Mosher, W. T. 115
Moss, C. S. 112
Motry, G. A. 129
Mountfort, Albert 121

Nelson, J. C. 119
Newcomb, E. W. 123
Newcomb, E. P. 128
Nicholson, F. L. 109

Orr, W. C. 103
Osgood, Jas. O. 100
Owen, G. B. 107

Paradis, F. E. 109
Parker, C. J. 108
Parker, John 128
Parker, J. F. 118
Parle, L. V. 130
Patenall, F. P. 124
Peabody, J. A. 126
Penwell, J. N. 121
Petri, Phillip 114
Pfeiffer, H. J. 100
Pflasterer, G. S. 124
Phillips, J. D. 127
Phinney, R. M. 127
Porter, H. T. 104
Post, E. K. 130
Post, W. M. 129
Potts, J. O. 120
Powell, C. E. 120
Powell, W. T. 121

Raviler, J. W. 130
Raymer, I. S. 126
Reid, Jas. M. 102
Reisler, Evan T. 113
Relph, E. J. 132
Rettinghouse, H. 112
Reynolds, John N. 133
Rhame, M. D. 109
Rice, D. S. 129
Richards, B. H. 132
Richards, D. W. 123
Richards, Jos. T. 105
Riney, M. 117
Robinson, A. F. 110
Rockwell, Sam'l 102
Rodd, Thos. 103
Rohbock, W. T. 120
Rose, L. S. 124
Rosenberg, C. C. 131
Rudd, A. H. 126
Russell, J. B. 107
Rutledge, R. A. 106
Schaffer, John 121
Schall, Fred E. 110
Schenck, A. A. 107
Schleiter, W. F. 134
Schultz, P. 130
Schwendt, B. J. 123
Seymour, A. W. 127
Shadwick, J. J. 132
Shaver, A. G. 124
Sheeren, E. J. 131
Sheldon, J. B. 121
Shillinger, J. G. 108
Simar, V. D. 116
Slater, W. W. 126
Smith, E. V. 114
Smith Henry C. 119
Smith, M. E. 125
Smith, R. C. 113
Smith, W. C. 105
Smith, W. L. 130
Snow, J. P. 120
Snow, T. W. 133
Soles, G. H. 120
Sommerville, B. V. 116
Sommerville, D. L. 113
Spangler, W. N. 128
Spaulding, Chas. L. 112
Spencer, Wm. 118
Stanton, George 134
Stein, C. H. 107
Stephens, Chas. 123
Stevens, F. S. 101
Strouse, W. F. 117
Stuart, F. C. 123
Stuart, F. Lee 104
Sullivan, J. G. 108
Swenson, P. 117

Taylor, D. M. 115
Temple, Edw. B. 109
Thompson, C. A. 128
Thompson, F. L. 120
Tinker, Geo. H. 110
Trimble, Robt. 99
Trout, R. E. 123

Uniake, R. F. 100

Van Craenenbroeck, F. H. 112
Van Schaick, A. P. 134

Walker, I. O. 115
Watson, E. L. 131
Webb, Geo. H. 102
Webb, W. L. 109
Wendt, E. F. 119
Wentworth, Chas. C. 112
Whitney, W. C. 121
Whittemore, D. J. 104
Wiegand, F. B. 127
Wiles, T. R. 134
Williams, H. C. 129
Williams, W. D. 100
Wilson, E. E. 121
Wilson, J. T. 114
Wood, B. A. 114

Young, J. C. 122
Young, J. V. 125

Zook, M. A. 108

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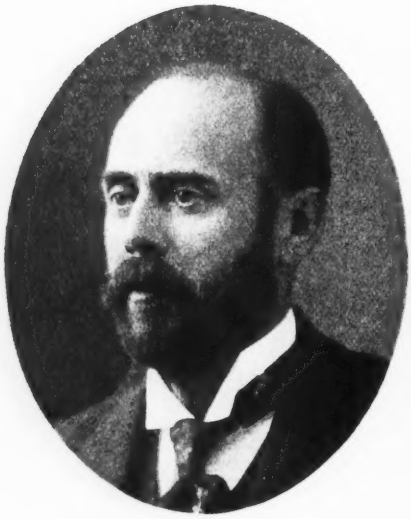

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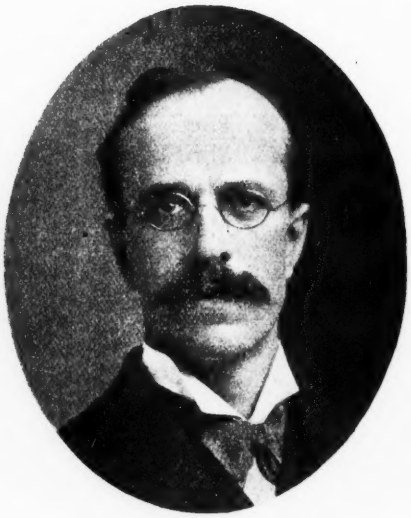

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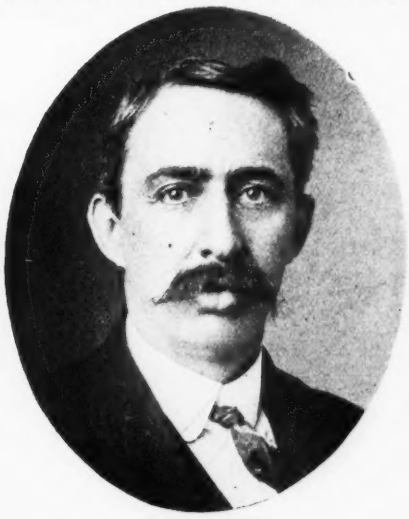

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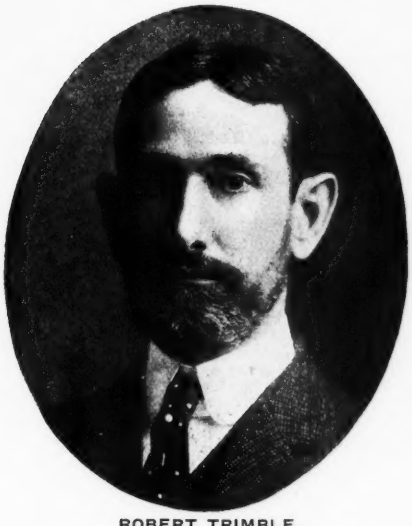

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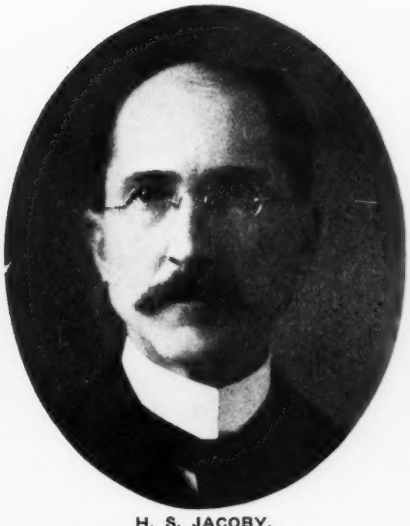

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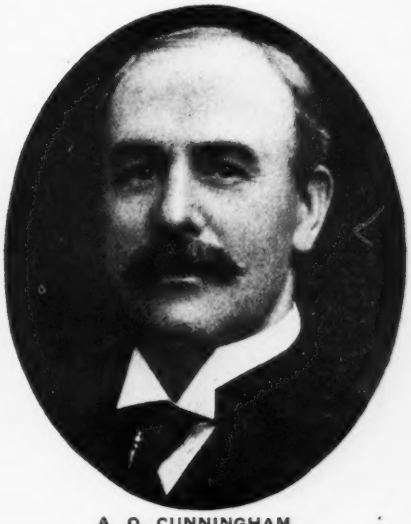

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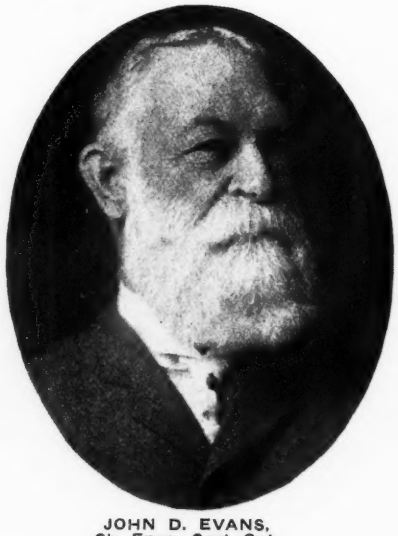

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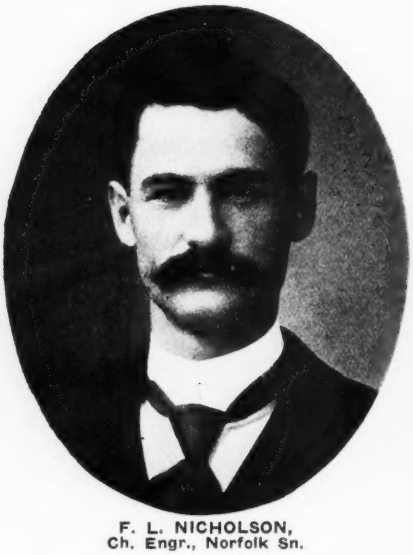

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E. C. CARTER,
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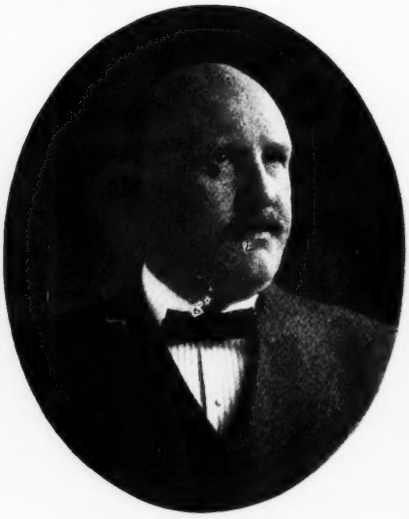

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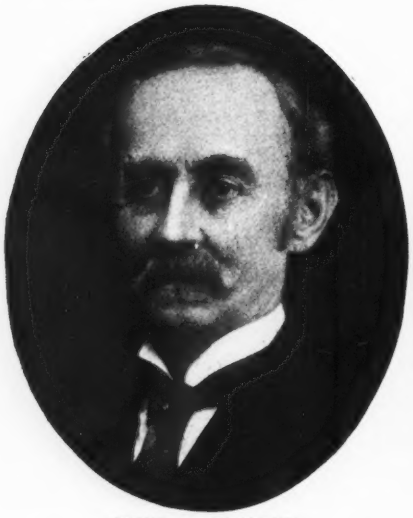
Ch. Engr., Cent. of Ga.

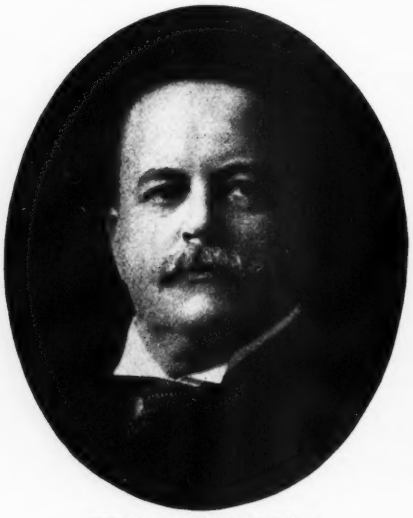
SAMUEL ROCKWELL,
Ch. Engr., Lake Shore & Mich. Southern.

JAMES M. REID.
Ch. Engr., Nat. Ry. of Mexico.

JOHN E. BLUNT.
Cons. Engr., C. & N.-W.



THOS. H. JOHNSON,
Cons. Engr., Penn. Lines (S. W. Sys.).



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Vice.-Pres. & Dir., Harriman Lines.

J. S. CHICK,
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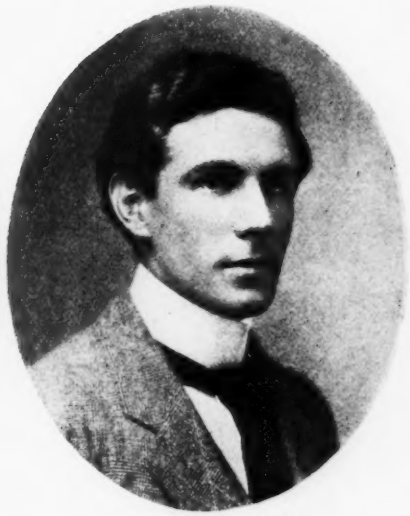
E. N. LAYFIELD,
Ch. Engr., Balt. & Ohio Chi. Term.

CHAS. B. JUDD.
Ch. Engr., Atlantic Northern & Southern.



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W. W. COLPITTS,
Ch. Engr., Kas. City, Mex. & Orient.

A. L. FOX,
Ch. Engr., Chi. Heights Term. Trans.

G. H. BURGESS,
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C. W. JOHNSON,
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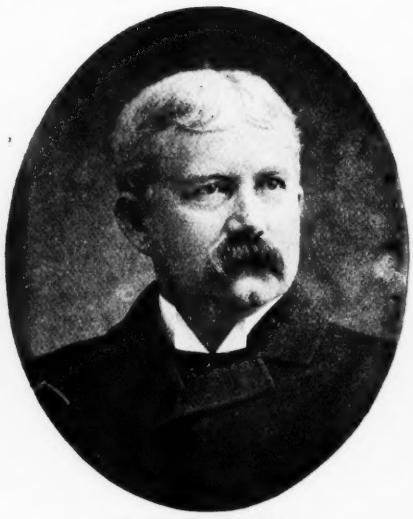
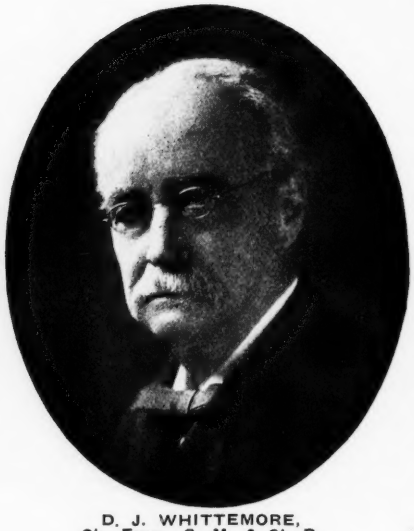


C. W. BUCHOLZ,
Cons. Engr., Erie R. R.

A. M. KINSMAN,
Consl. Engr., B. & O.

J. A. ATWOOD,
Ch. Engr., Pitts. & Lake Erie.



D. J. WHITTEMORE,
Ch. Engr., C. M. & St. P.

ARTHUR MONTZHEIMER,
Ch. Engr., Elgin, Joliet & Eastern.

F. L. STUART,
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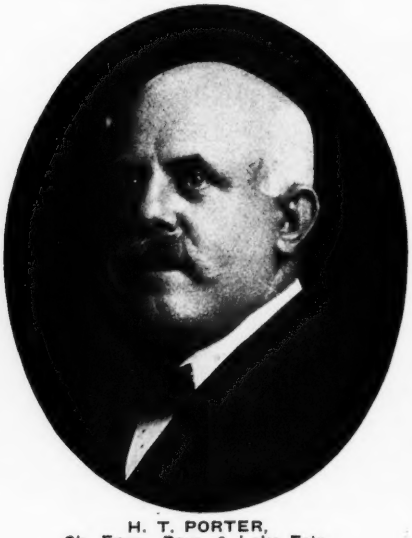

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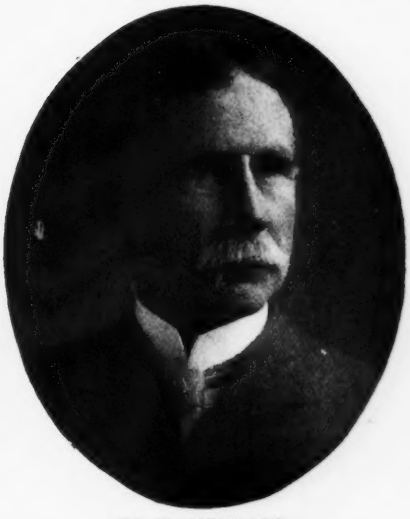
M. J. BURGDORF,
Ch. Engr., Florence & Cripple Creek.

E. B. KATTE,
Ch. Engr. Elec. Trac., New York Central



JOS. T. RICHARDS,
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W. C. SMITH,
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M. L. BYERS,
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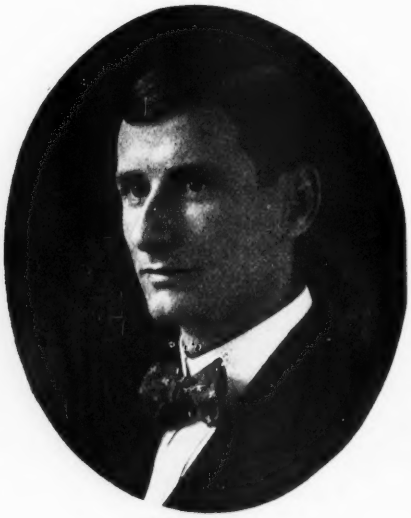
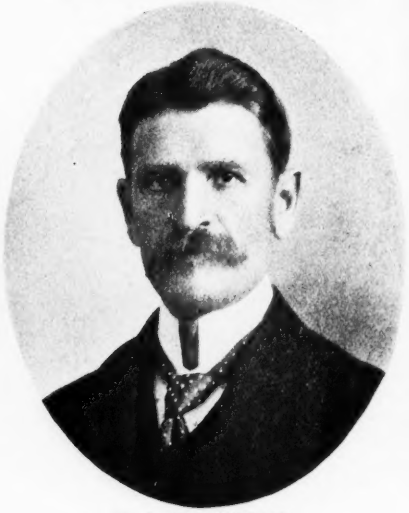
GEO. H. HERROLD,
Engr. M. of W., Chi. Gt. Western.

C. DOUGHERTY,
Ch. Engr., Cincinnati, N. O. & Tex. Pac.



EDW. GRAY,
Engr. M. of W., Southern Ry.



M. S. BLAIKLOCK,
Engr. M. of W., Grand Trunk.

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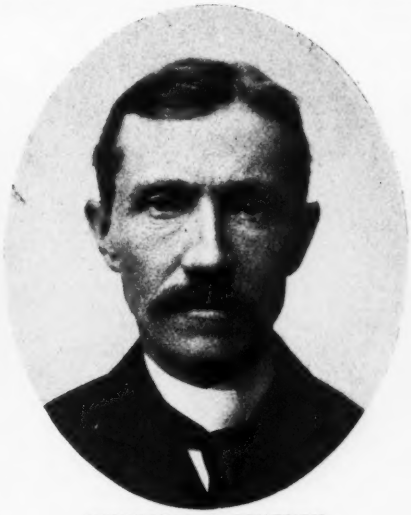
H. GATLIN,
Engr. M. of W., Southern Ry.



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J. T. FRAME,
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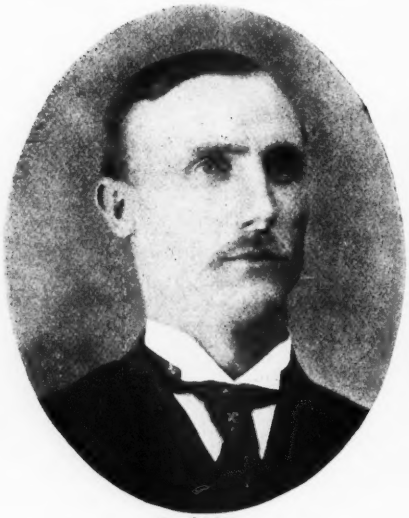
T. C. BURPEE,
Engr. M. of W., Intercolonial Ry. of Can.



P. CAIN,
Engr. M. of W., Westn. Md.

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M. A. ZOOK,
Const. Engr., Chi. Gt. Westn.

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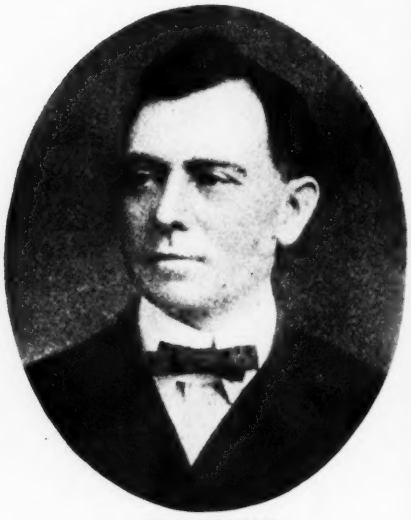
Asst. Ch. Engr., C. & N.-W.



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M. D. RHAME,
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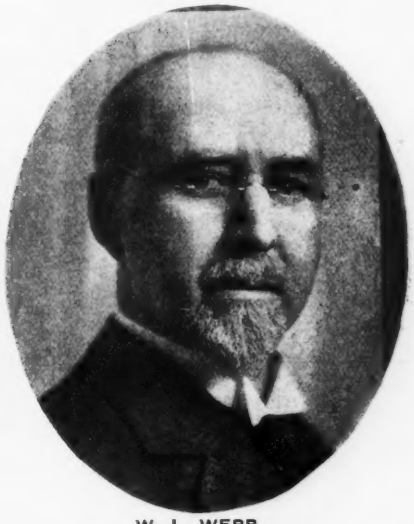
ROY JOHNSON,
Div. Engr., C. R. I. & P.



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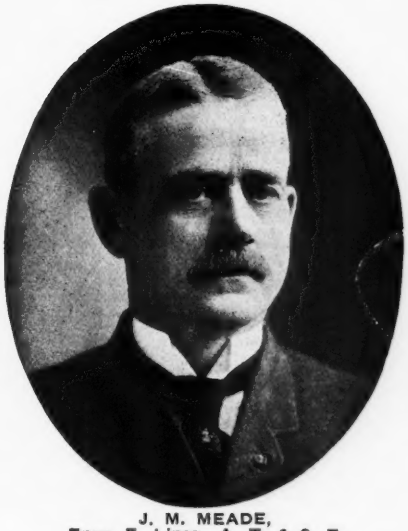
Dist. Engr., C. M. & St. P.

F. T. BECKETT,
Res. Engr., El Paso & S. Westn.



J. M. MEADE,
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EDWARD B. TEMPLE,
Asst. Ch. Engr., Penn. R. R.

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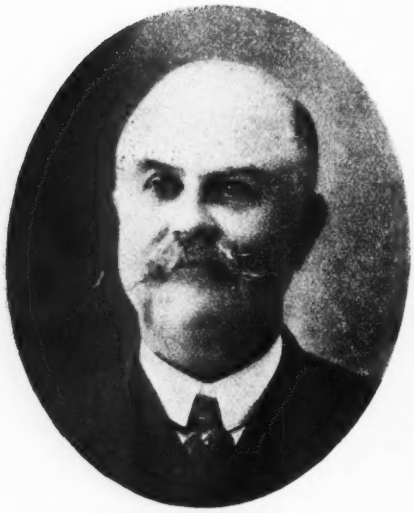
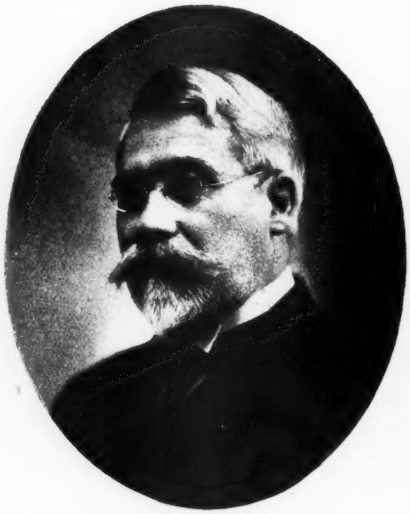


F. M. BISBEE,
Engr. Westn. Lines., A. T. & S. F.



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Engr. Bridges., Penn. Lines West.

JOHN A. BOLAND,
Bridge Engr., Great Northern.

A. F. ROBINSON,
Bridge Engr., A. T. & S. F.

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Div. Engr., Mo. Pac.

J. D. KOREN,
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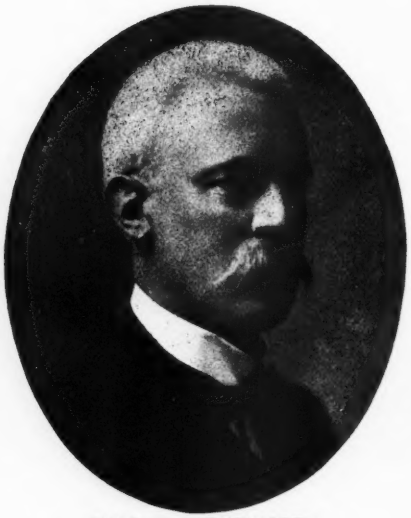

CHAS. C. WENTWORTH,
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RAYMOND C. SMITH,
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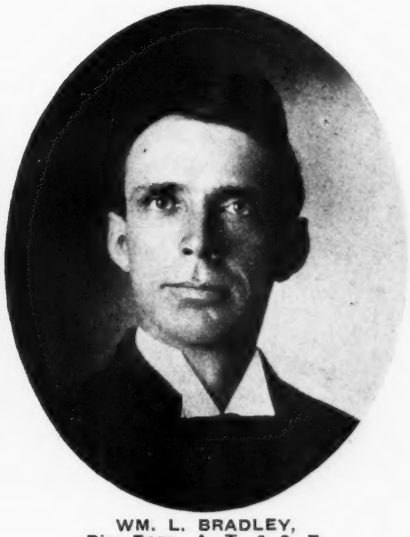

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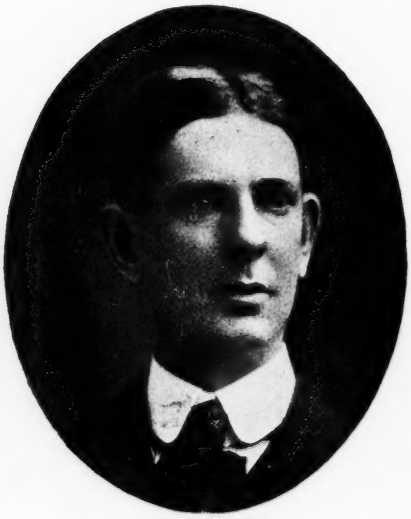
Dist. Engr., C. M. & St. P.

FRANK STUART HUNT,
Div. Engr., New York Central.



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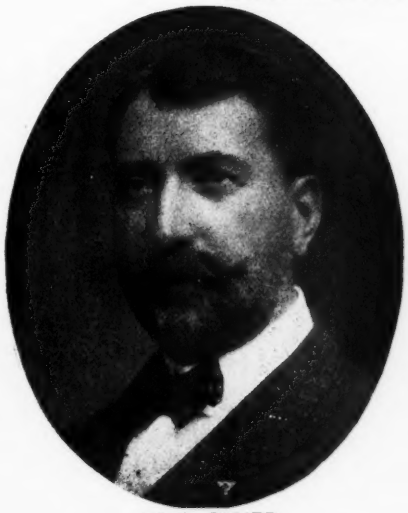

PAUL DIDIER,
Prin. Asst. Engr., Balt. & Ohio.

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Off. Asst. Engr., New York Cent.

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Asst. Engr., Southern Ry.

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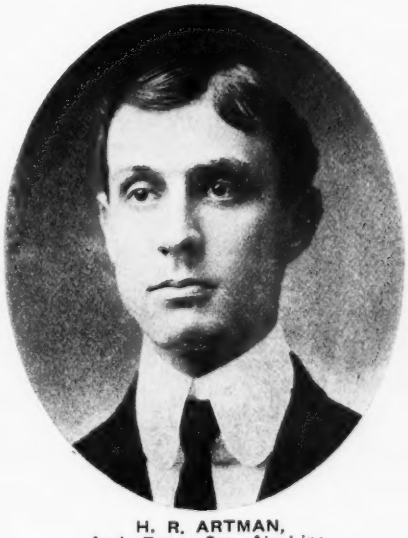
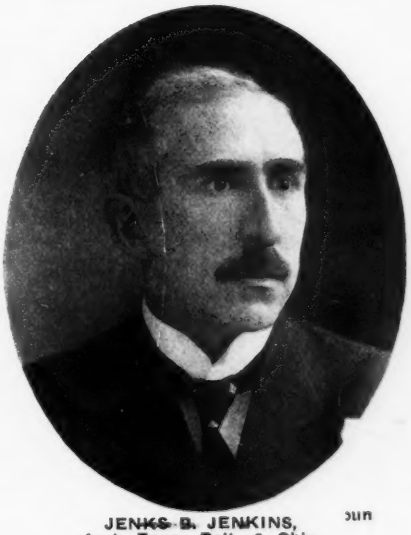
D. M. TAYLOR,
Asst. Engr., Wheeling & Lake Erie.

C. McC. LEMLEY,
Asst. Engr., Balt. & Ohio.



H. R. ARTMAN,
Asst. Engr., Sea. Air Line.



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J. A. LAHMER,
Prin. Asst. Engr., Kas. City Southern.

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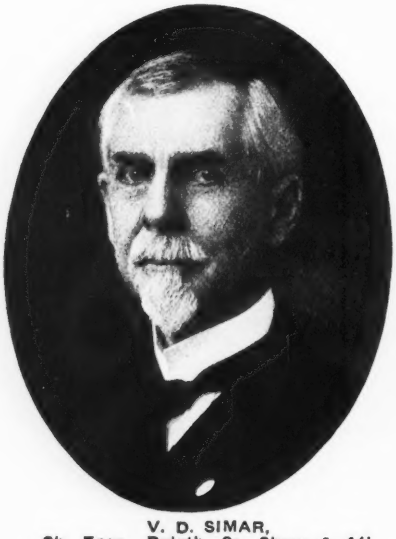
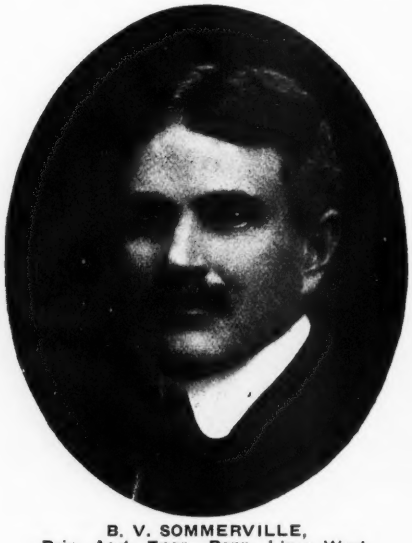
E. G. ERICSON,
Prin. Asst. Engr., Penn. Lines (N. W. Sys.).

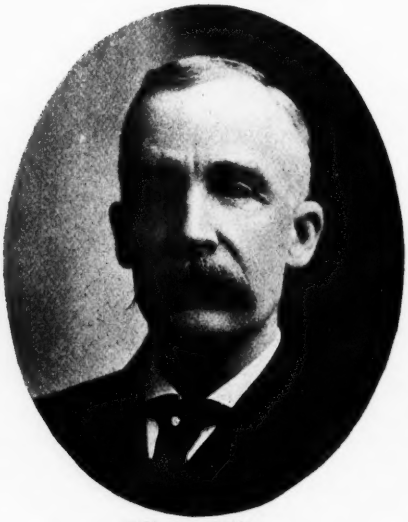
CHAS. H. HITCHCOCK,
Asst. Engr., Phila. & Reading.



V. D. SIMAR,
Ch. Engr., Duluth. So. Shore & Atl.



B. V. SOMMERVILLE,
Prin. Asst. Engr., Penn. Lines West.



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Prin. Asst. Engr., Southern Ry.

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L. KINGMAN,
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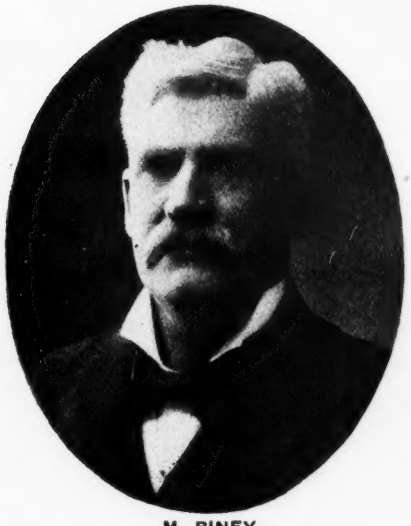
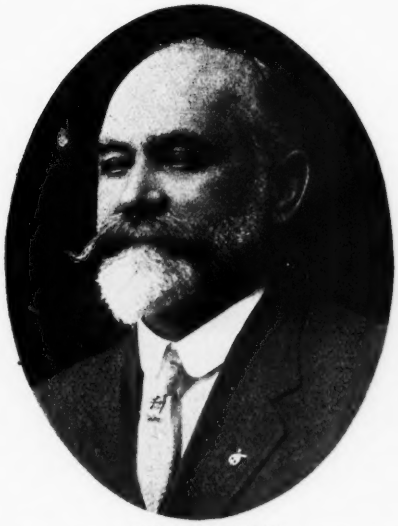
W. F. STROUSE,
Asst. Engr., Balt. & Ohio.



M. RINEY,
Supt. B. & B., C. & N. W.

P. SWENSON,
Supt. B. & B., Minn., St. Paul & S. Ste. Marie.

E. M. CARTER,
Supv. B. & B., Tenn. Cent.



HANS HELLAND,
Supt. M. of W., San. Ant. & Aransas Pass.

P. C. BROWN,
Supt. B. & B., Columbia & Puget Sound.

F. O. DRAPER,
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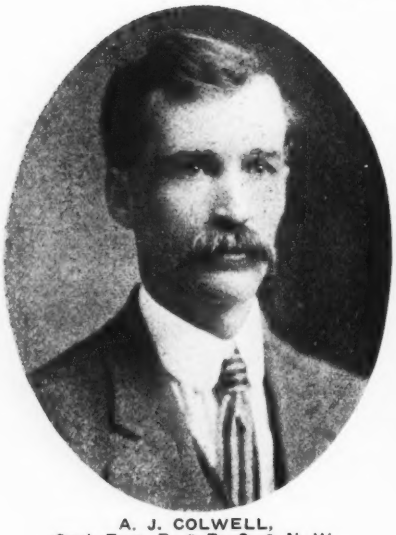

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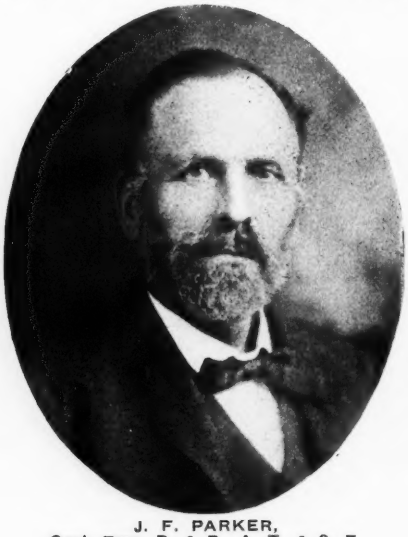

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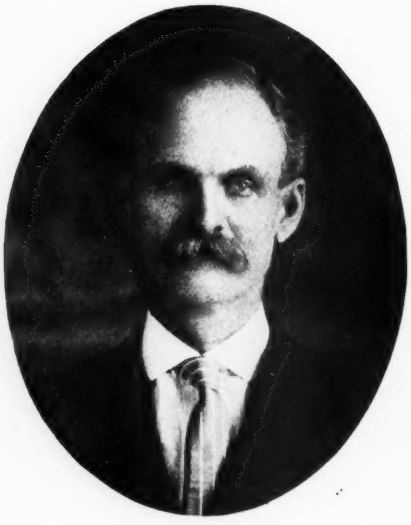

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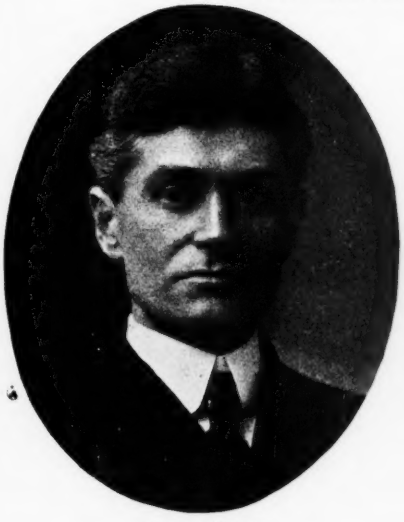

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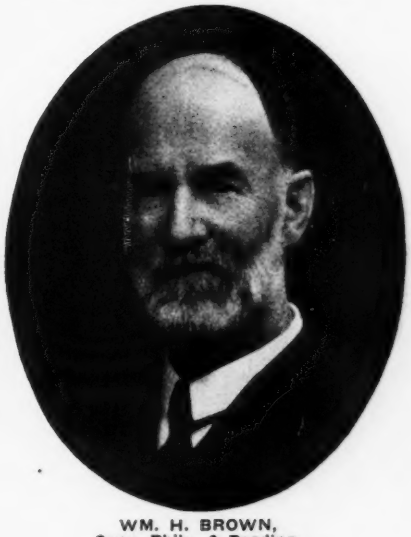

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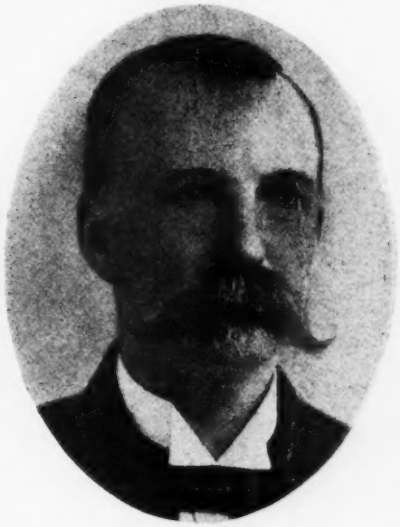

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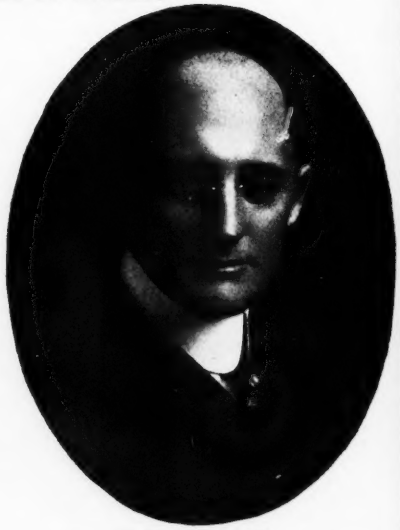

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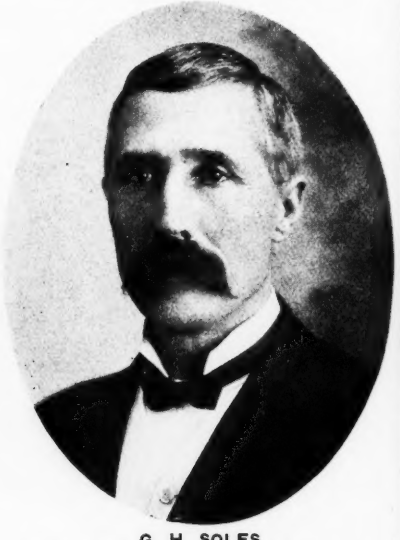

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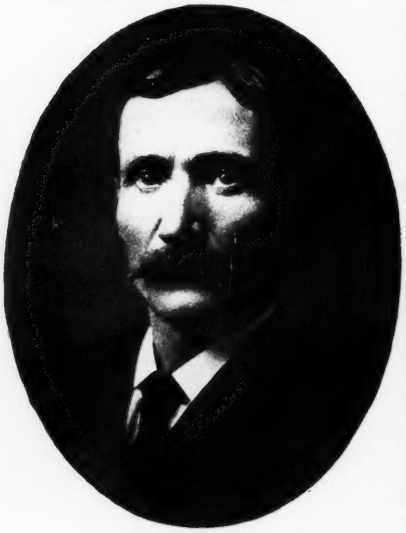

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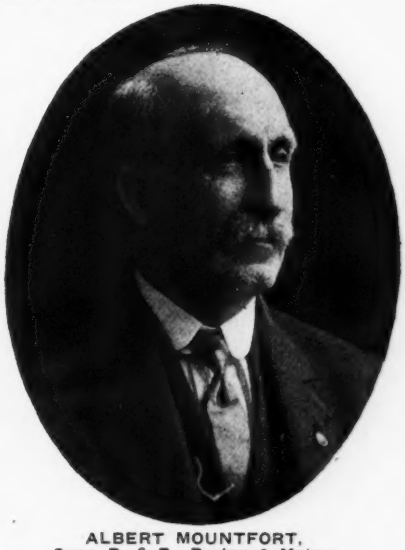

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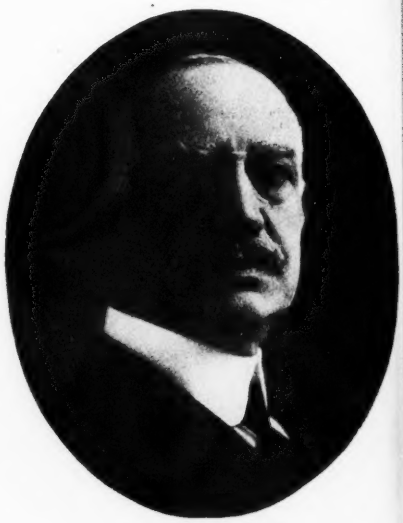

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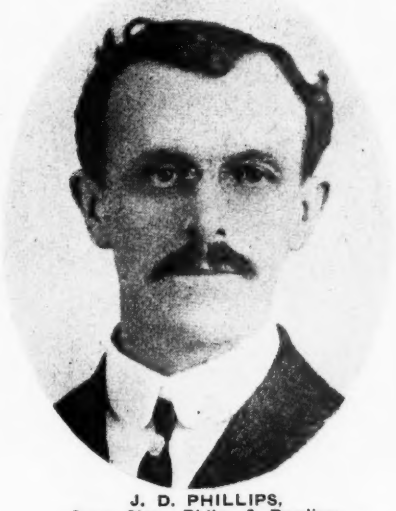

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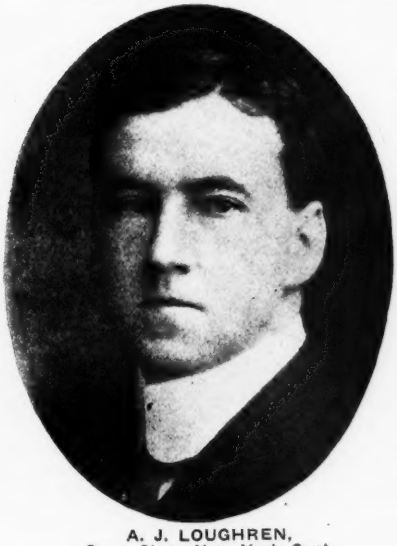

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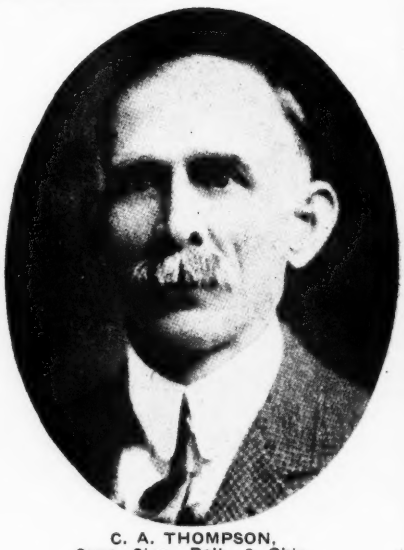

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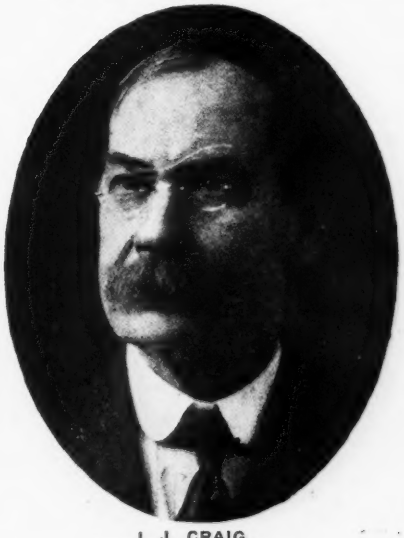

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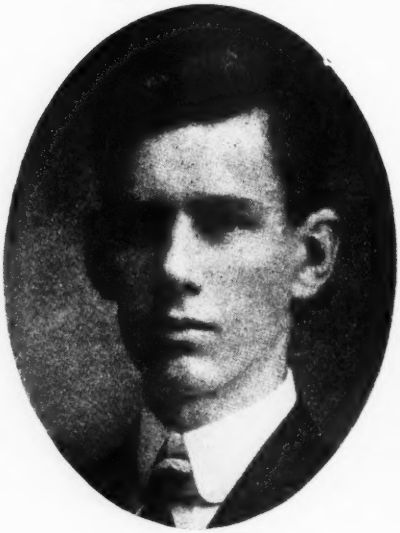

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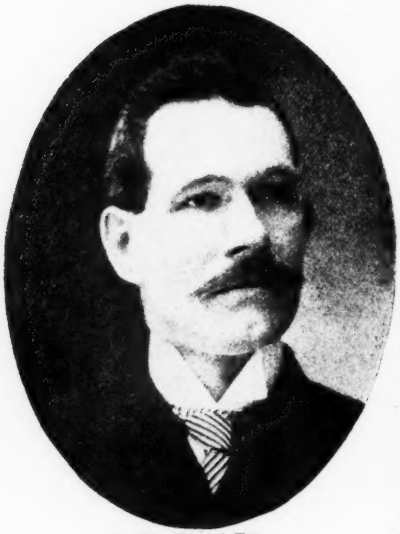

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Waterproofing of Subways

By F. H. Avery, Mem. A. S. C. E.

In the summer of 1908 the writer had charge of waterproofing subway floors for the Chicago Terminal Transfer R. R. Co. With no previous experience in waterproofing the then established method of prepared mastic was used. This mastic was furnished by the Standard Asphalt and Rubber Co., and was delivered in blocks weighing about 80 lbs. and consisted of Sarco flux gilsenite and gravel.

The blocks were broken up and melted in asphalt kettles; sand gravel and more flux was then added until the mastic would just barely flow when placed on a piece of burlap and allowed to hang in a vertical position.

The subways were all trough floor construction filled with 1 to 4 concrete and the surface finished as smooth as sidewalk finish with the proper slope for drainage. The concrete when thoroughly dry was painted with Sarco Primer, which is a liquid applied cold like a paint, and serves to close up the small holes in the concrete and also to prevent wetting in case of a rain. About 8 to 10 days of dry weather was allowed for drying. The concrete thus prepared was given a hot swabbing coat of Sarco No. 6 and was then ready for the waterproofing.

The waterproofing was applied in two layers each about ¾-in. thick. The mastic was carried out to the floor in wheelbarrows, the wheelbarrow being oiled to prevent the mastic from sticking. The mastic was dumped on the floor and then rubbed out smooth by wooden floats. It was applied in sheets about 2′ 6″ wide parallel to the tracks and hardwood strips were used to finish against. When a sheet had been laid the hardwood strip was pulled up and moved over and before laying the next sheet the edge of the last section was given a hot swabbing coat to be sure of obtaining a good bond. After the first layer had been laid the second was applied in the same manner, lapping the joints about 6″.

The ends of the floor and the slope of the facia girder were covered with a curtain consisting of 3 ply of 40″ open mesh burlap, each layer swabbed with Sarco No. 6 and then mastic about 1½-in. thick applied on top. This last operation was a difficult one and gave a very uneven and lumpy surface when finished. At the top of the facia girder a hook was formed to hold the curtain from sliding down, for the burlap when swabbed would not adhere to the concrete. In fact it could be lifted up much the same as a rug.

The facia girder was made as shown in Figs. 1, 2 and 3, the expanded metal and ¼″ rods being built up like a fence before the forms were put up. The ¾″ corrugated bar at the bottom was added to permit tension cracks in the stret span due to deflection.

The burlap was laid in the hook and then mastic rubbed into the hook. The ⅜-in. drip plates were omitted in later floors as they were found very hard to get into the forms and could not be placed until the form was filled.

The slopes in the concrete, shown in the side elevation Fig. 2, were obtained by cutting strips to the required taper. These strips were made of 4″ lumber to prevent turning over and braced to the troughs for the same reason. The concrete was levelled off between the strip and the adjacent section of finished floor by wooden straight edges and then when partly set was troweled smooth. The floor was concreted in two portions, the troughs being filled first and then the lap or finishing coat added.

All of the floors waterproofed by mastic leaked very freely and for the following reason. The mastic was too hard to allow contraction without pulling open the joints. Even when the joints were thoroughly ironed with hot irons this occurred, in several cases a small piece being pulled out of the adjoining strip. The joints opened up about ⅛″ both in the top and bottom layer and the water running down the upper crack found its way to the lower joint and thus reached the concrete and appeared as a leak. This path of the water is not imaginary, for a section of the water proofing was taken up and the path of the water clearly traced by the wet surface shown along the lines just indicated. An attempt was made to remedy this with swabbed strips of burlap over the cracks, but the cracks soon appeared through the swabbed burlap and then the floor leaked again.

So much trouble was experienced with this method of waterproofing and such unsatisfactory results obtained that when the season's work was over experiments were made to obtain some easier and more watertight method. Three specimens were made as follows:

Side View of Waterproofed Concrete Viaduct, Showing Paneling in Facia Girder.

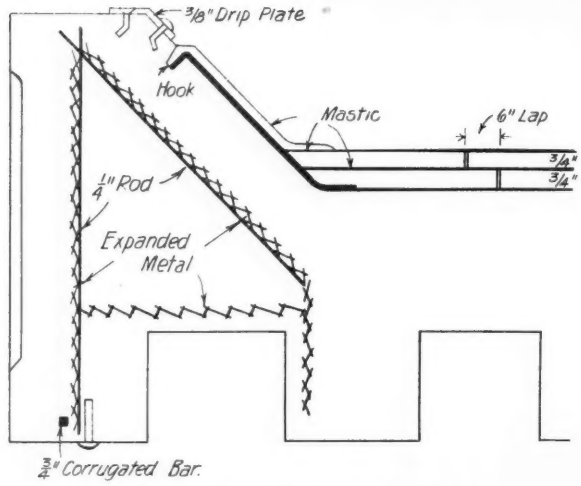


Fig. 1. Waterproofing of Subways.

1. Three layers burlap, each with one mopping coat Sarco No. 6.
2. Same as No. 1 with two mopping coats on top.
3. Same as No. 1 with three mopping coats on top.

The samples were about 6 ft. long and of course 40" wide. They were nailed to frames so as to form a sort of shallow bath tub and kept full of water for two weeks. All three were perfectly dry at all times on the under side, and remained so even when they were bent and rolled like a rug. No. 3 was then kept for some time under a temperature of 110 and did not flow or become sticy. It was then placed out in the weather at about zero temperature. When an attempt was made to bent it, it cracked in very fine cracks but none of the material would fly out, as it was too tough and thoroughly bonded to the burlap. At moderate temperatures the pieces could be stretched quite appreciably without developing cracks or injurying their water proofing property. It was then considered that the probelm had been sufficiently investigated to warrant using method No. 3 for the following season's work. Specimen No. 3 weighed 1½ lbs. per square foot, of which 1 lb. was sarco No. 6, and ½ lb. was burlap. This would correspond to 1,000 lbs. of No. 6 per track, as one track represented nearly 1,000 sq. ft. when the length of curtain at each end was counted, this curtain being long enough to come well below the bridge seat and thus seal the joint in the concrete at this point.

It is very important that the curtain should be long enough to seal into the concrete below the bridge seat (as shown in figure 2), for on subways where the curtain was not carried down far enough the water came through the bridge seat and ran down the face of the abutment to the sidewalk. A 6-inch farm tile was placed at the end of the curtain and sloped to catch basins, in some cases passing through the abutment and under the sidewalk. This removed the water carried off the bridge. A cinder fill as shown in Fig. 2 was placed around the tile so as to give the water ample chance to reach the tile.

When waterproofing commenced in 1909 the details of applying the new method were changed as experienced was gained in the field. The priming coat was still used, but was not at all necessary, further than as a protection in case of rain. This priming coat could be omitted in fair weather, for it is of no value as a waterproofing material, because it is beneath a mat that is much more water-tight.

The burlap in bolts was rolled up one bolt at a time on short pieces of 1-inch pipe, a rough machine being made for this purpose. This machine consisted of a base and stand of wood with two holes in the uprights to admit the 1-inch pipe, and a rough wooden crank to slip over the pipe. An arm extended horizontally from each upright of the machine and these arms supported a 1-inch pipe, over which the burlap passed when being rolled. Enough rolls were prepared in advance to cover one track.

The Sarco No. 6 was received in shell iron drums weighing about 450 lbs. The sheet iron was removed and the drum cut up in circular sections by means of a wire passed over the drum and wound up on a shaft set in rough wooden standards; the shaft was turned by an old wagon wheel. These sections were then cut up smaller with an ax and placed in the melting kettles.

A small piece of floor was swabbed and then a roll of burlap laid down so it would unroll parallel to the track. This was moved ahead by two men and one man followed sweeping out the wrinkles with a broom. One man mopped ahead of the roll and two carried the mopping pails, thus making six men out on the floor. One man tended kettles and he had two helpers to chop wood for fuel and to charge the kettles, so the gang consisted of nine men and one foreman. The men received $1.75 for 10 hours and the foreman $3. The end curtains were laid separately, as it was found awkward to let the roll go over the end of the floor. The side curtains were laid after the floor was placed. It made no difference how the material lapped, as the swabbing coats made it all one piece that could easily be lifted up and rolled back.

When one strip had been laid the length of the bridge the next strip was started, lapping back 1 ft. on the first, and rolled and swabbed in the same manner. This gave three thicknesses of burlap when completed and the top of the entire floor showed the bare burlap. The finishing coats were applied last so as to keep a surface that could be walked upon without injury as long as possible. Next, starting at one side, a piece about 30 ft. wide was given three swabbing coats applied considerably cooler than the coats between the burlap. This gave a thicker coating and more body to the mat. The entire surface was covered in this man-

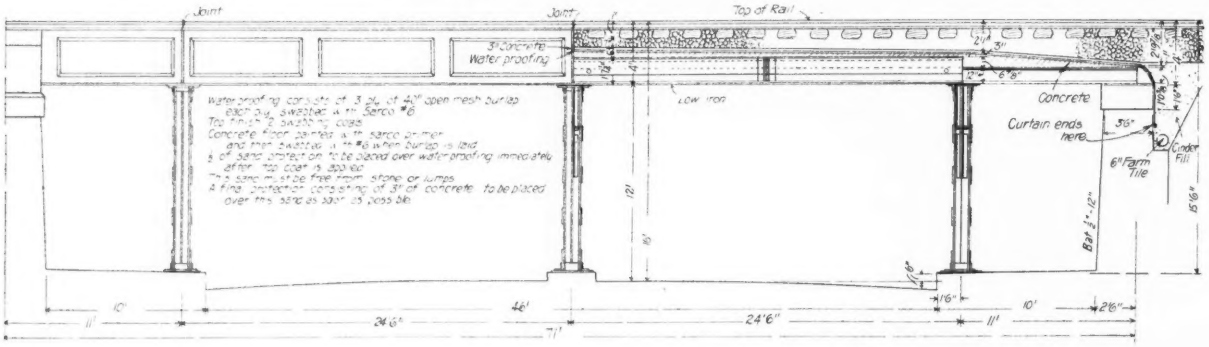


Fig. 2. Waterproofing of Subways.

ner. At first sand was placed on the surface thus prepared, but it was found almost impossible to keep stone and cinders out of the sand and so the sand was omitted and the protecting coat of concrete (1 to 4) applied directly on top of the waterproofing. This protecting coat took the place of the hard mastic. It was made 3 inches thick so as to make sure that any cracking that might take place would not permit a small piece of concrete to turn down into the waterproofing as might easily occur if the coat of concrete were only an inch thick.

The concrete was placed on the waterproofing from a finished portion and then as it began to cover the easily injured surface of the mat, all work was done on top of the wet concrete, boards being laid to wheel and walk on and in this way there was no occasion to work on the unprotected surface. At the side and end curtains this concrete had to be made much thicker in order to get up the incline without the use of a form. The vertical part of the end curtain was not concreted, but sand was placed against the curtain while the cinder fill was being made. When the bridge seat was reached the concrete protection was started on top of the cinders and run over the curve as shown in Fig. 4.

In the 1908 work expanded metal was placed in the floor at the top of the troughs and metal lath in the 3-inch protecting coat, but both were omitted in the 1909 work for the following reason. The concrete in the floor is not of itself waterproof and so cracks could not seriously affect it and it does no harm if the protecting coat cracks. Omitting this metal made the work in the field much easier and reduced the cost considerably.

As shown in Fig. 2, joints were made by means of tarred paper over each column, for it was surmised that the deflection would develop a crack there. In fact, this crack soon did develop and would extend clear across the floor in a short time.

The following advantages were soon noticed in the 1909 work. First and most important, the waterproofing was found to be waterproof and to stay so. It was cheaper, more quickly applied, and did not need so much skill in laying or tempering the mixture at the melting kettle. It was not possible to bring out a batch that was burnt so as to get a spot that would have to be chopped out and replaced. It could be easily worked around corners, over curves and up vertical surfaces. It required fewer men and tools in a gang, and so it was easier to move from subway to subway. No trouble was experienced in continuing a piece of waterproofing partially laid by simply mopping the edge of the last piece, which was allowed to project about a foot beyond the concrete covering, and starting the burlap on this projecting strip. The bond formed was so tight that it would lift the old portion when pulled up. Any puncture was easily repaired by mopping, applying a piece of burlap, and mopping again. This process had to be repeated frequently.

Also the following precautions soon had to be observed. The men's shoes became coated with the mopping and picked up stones, cinders and gravel, and when they walked out on the floor these foreign substances would get under the burlap and could be detected when stepped upon, as this forced them to the top. They could be cut out with a pocket knife and the place patched, but in order to avoid this trouble the ground around the kettles was planked and a plank laid to the floor. These planks were swept by a man whose sole occupation was to see they were kept clean and then the floor men were compelled to stay on these planks when working. This was found to be the most important pre-

Unfinished Viaduct, Showing Steel Construction.

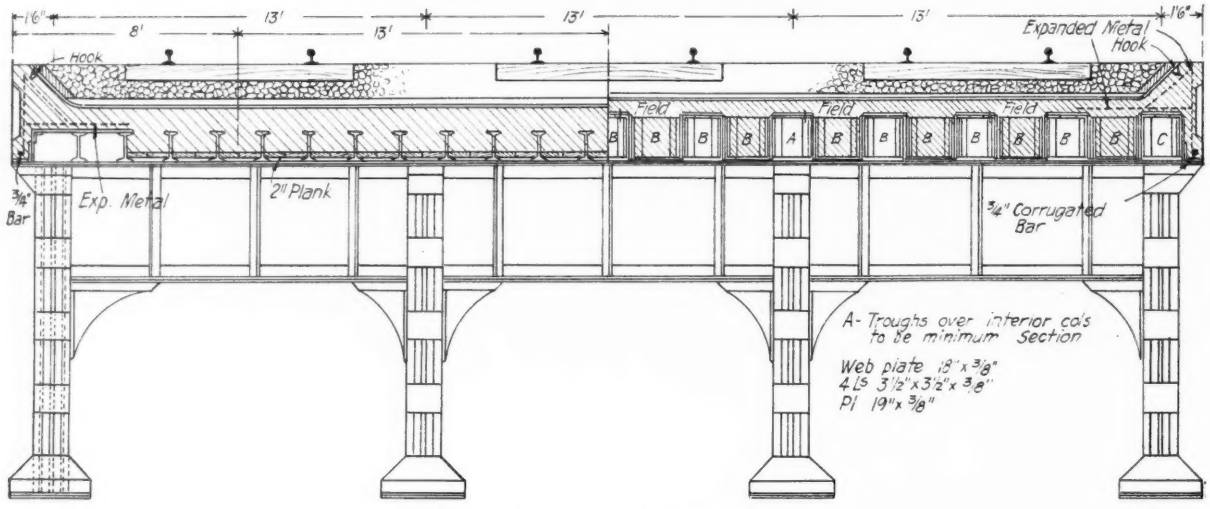


Fig. 3. Waterproofing of Subways.

caution to be observed, as failure to do this invariably ruined the floor.

The last job to be treated in this manner was the Fifth Avenue approach to Polk Street viaduct. There is a bonded warehouse beneath this approach, and the bridge floor had to be tight, as it formed the roof of the warehouse. A curtain wall was built at each side of the viaduct and a V-shaped piece of concrete laid along this wall after the concrete in the floor had been laid.

The waterproofing was then laid vertically up the curtain wall as shown in Fig. 5, a V being left at the top. This V was filled with swabbing mixed with a little sand to make it hard. The protection coat was then added and formed the roadway curb at the side as shown in Fig. 5. This floor has proved absolutely tight up to date.

To the writer the details at the sides and ends of the floor appear to be very important, for if they are not carefully thought out in advance of the work (that is, if they are left as a detail to be taken care of in the field) there is liable to be enough leakage at these points to ruin any good work in the body of the floor.

The entire success in this method of waterproofing lies in having a careful foreman who will personally stay on the floor all of his time and not try to run the job half a mile away from the floor, for the men, if left alone for a short time, will fool handle the work to destruction, as they are generally a cheap class of labor.

This article is written with the idea of helping some brother engineer who has never had any waterproofing to handle personally and who upon running into such a job would like to know what someone else did to get satisfactory

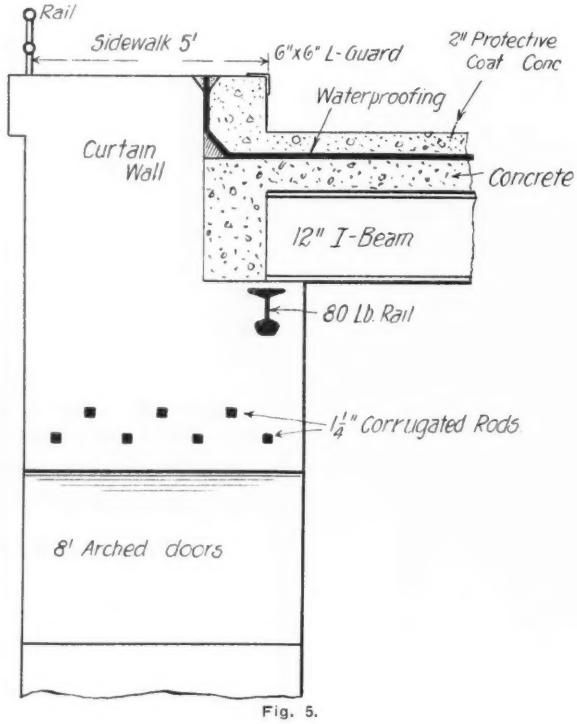


Fig. 5.

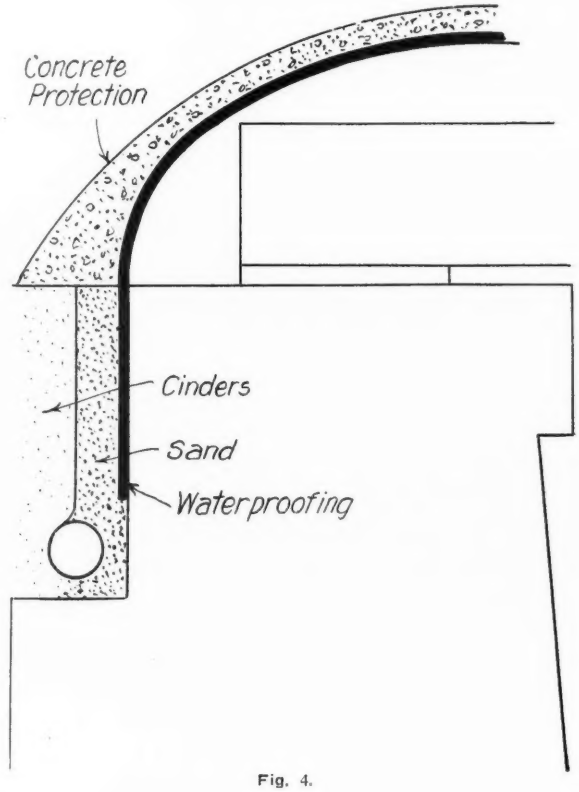


Fig. 4.

Side View of Viaduct Under Construction.

results, and thus save himself the mortification the writer has had of laying a waterproof floor that leaked like a sieve.

As regards cost, the following were taken from work done on the subways at Lincoln and Robey, in both cases the work being hampered by taking care of traffic during the waterproofing.

	—Lincoln St.—		—Robey St.—	
Area of floor, sq. ft.....	5,625		5,318	
	Cost.	Per sq. ft.	Cost.	Per sq. ft.
Waterproofing	$504.72	$0 090	$347.58	$0.065
Concrete protection	333.31	0.059	368.11	0.069
Engine service	107.64	0.019	47.25	0.009
	$945.67	$0.168	$762.94	$0.143

This was more than one-third cheaper than the best results obtained using the mastic. Lincoln Street leaked, due to the fact that it was the only street where the concrete floor of the subway was not troweled smooth. In fact, there were several places where men had sunk into the soft concrete for a depth of 6 inches, and although pains were taken to fill these holes and trim off the sharp edges, it is very evident that these sharp edges cut through the mat and caused the leaks. This was the only street waterproofed in this manner that leaked and in this case the waterproofing was not to blame. The entire thickness of the three coats of burlap and top swabbing coats is only ½ inch, so that putting it on a surface such as was found at Lincoln Street was pretty certain to invite leaks.

One more precaution suggested by the results at Lincoln Street is to carefully examine the floor before starting to waterproof and remove all small stones sticking up out of the concrete. Also cut off the sharp edges at the ends of the floor where the floor concrete rests on the bridge seat. This was done in advance of the waterproofing gang and is an absolute necessity. The protection coat of concrete was reduced from 3 inches to 2 inches in order to get more room under the tie.

This work was done under Mr. E. N. Dayfield, chief engineer C. T. T. Ry.; Mr. F. E. Lamphere, engineer in charge of track elevation, and the writer, who handled the steel work and waterproofing.

J. A. Fay & Egan Co. announce the discontinuance of their Greenboro, N. C. agency. The Chattanooga, Tenn., office has also been discontinued and a new suite of offices opened in the Candler Bldg., Atlanta, Ga. The new Atlanta office will handle all business in the states of North and South Carolina, Tennessee, Georgia, Florida and Alabama (outside of Mobile). S. Lee Smith, Benj. H. Cox, Jr., and D. E. Gray, will now make Atlanta their headquarters.

Finished Waterproofed Concrete Viaduct.

WHAT COMPRISES GOOD INSULATION.

By Lewis G. Martin.

To a close observer it has always been remarkable that electrical lines of communication perform the work required of them as well as they do. In the first place, only a comparatively short time ago little or no importance seemed to be attached to real insulation, judging by the way wires were run, tapped and connected up, and, in fact, there are only too many instances where like conditions prevail today, although there appears to be a genuine desire for improvement among those who have "looked and seen."

The strangest part is that all electrical men know that to give good service wires must be well insulated, and will demand good insulators if they are purchasing bare or weather proof wire, and reliable insulation whether paper, varnished cambric, fibre or rubber, if the wires are to be used for interior or underground purposes, and yet how few really take the trouble to determine whether they receive what they actually demand, or, to put it another way, how often is the material properly and adequately tested before and after being put into service?

It is all very well to depend upon the honesty and reliability of the manufacturer, and it is comforting to know that there are those who can be absolutely depended upon for delivering what is required and promised, but it is a fact, nevertheless, that these latter are very few compared with those who, in their endeavor to secure patronage at ruinous prices, are willing to take every advantage of the knowledge that no tests will be made on the completed material.

What is the result? Insulators of all kinds that do not properly and lastingly insulate; that is, to anything like the extent the purchaser is led to believe they do. In no case is this more true, perhaps, than in rubber insulated wires, in the insulation of which rubber is the vital ingredient.

Beginning with the so-called code wire, we have a product in the covering of which there is the most minute quantity of rubber, and that of the very lowest grade procurable, and in one well known instance absolutely no rubber of any kind in the insulation at all. The next in line is the intermediate and allied grades which contain a slightly greater percentage of the same kind of apology for rubber, in some cases possibly mixed with a small amount of a better grade, or even fine Para; and, finally, there is the 30 per cent fine Para rubber insulation, than which, for durability and reliability, there is no superior.

While the two former classes are suitable for certain kinds of work (on the principle that there is a use for everything) where no risk to life and property is involved, the same interest does not attach to them as to the last mentioned, because they are usually sold for what they really are; but it is different where there is risk to life and property, because it is in such cases the very best of insulated wire should be used.

The best being that of which the insulation is composed of 30 per cent of fine Para rubber, the question as to the means of distinguishing such an insulation from those inferior to it at once arises. Let us see what means there are.

The first and most important thing to be determined is whether the correct amount of the right quality of rubber has been used, and this can be decided by a combination of tests of importance in the order named:

1. Chemical.
2. Mechanical.
3. Electrical resistance.

1. The compound on chemical analysis should show a percentage of resinous extract not greater than hereafter referred to; not more than from 3 to 4 per cent of solid waxy hydrocarbons; not more than .75 per cent of free and a total of 2.75 per cent of sulphur in any form, and should have a specific gravity of not less than 1.75.

2. The compound should stretch well with a moderate "set" and have a high tensile strength.

3. It should have a high electrical resistance, or, as it is more commonly called, high megohms.

If the above conditions are all met there is every practical assurance that the compound is a 30 per cent fine Para rubber.

Now, as to the meaning of these conditions.

Chemical Test.

Pure fine Para rubber contains from 1.5 to 3.5 per cent of resinous matter which slightly increases on vulcanization, so that if a 30 per cent compound shows on analysis not over 30 per cent of the maximum as above of resinous extract, it is reasonably certain that fine Para rubber of best quality has been used.

The limiting of the percentage of sold waxy hydrocarbons is an important feature as preventing the overloading of the compound with large quantities of bulky material which very markedly reduces its tensile strength and electrical efficiency.

The small percentage of free sulphur permissible is on account of its destructive effect (if present in any great quantity) on the copper wire, should the tin or other protective covering become detached from the wire, and the total amount of sulphur allowed is confined to the amount actually necessary to properly vulcanize the compound, which also has a direct bearing on the possible amount of free sulphur.

The high specific gravity is important as ensuring a proper ratio by volume of rubber to filler, a necessary condition of a high grade rubber insulation.

Mechanical Test.

Practically determines the amount and quality of rubber, and decidedly whether properly vulcanized or not. If under-vulcanized the sample will take up an excessive permanent set, while if over-vulcanized it will fail to meet the maximum stretch and tensile test. A fair mechanical test for a 30 per cent fine Para rubber compound is as follows:

Take a sample of the vulcanized insulation four inches, or longer, in length, and place marks on it two inches apart; then stretch it until the marks are six inches apart and immediately release it; then stretch again and breakage should not take place until the marks are at least ten inches apart. The tensile strength should be not less than 1,000 pounds per square inch. Such tests should be made at a temperature of 50 degrees Fahrenheit or above.

Electrical Tests.

A 30 per cent fine Para rubber insulation should give high megohms. This is amply borne out by actual test and is proved by the figures obtained from the grade of wires previously referred to in this article. For a given size and thickness of wall of insulation the results are substantially as follows:

Code wire	150 meghoms per mile
Intermediate	500 megohms per mile
30 per cent of rubber	1600 megohms per mile
30 per cent fine Para	3000 megohms per mile

It is often remarked by the manufacturer of the cheap grade of wire, and even by some who claim to be making a 30 per cent fine Para rubber insulation, that high megohms do not indicate the quantity and quality of the rubber employed. An unanswerable reply to this is that in the comparatively few cases, such as for submarine cables, or where extraordinary flexibility is required and 40 per cent of fine Para rubber is asked for, the megohms demanded are usually twice as high as those for a 30 per cent compound. Another argument frequently heard is that on account of the improved methods of extracting the resins from the raw rubber any kind of rubber can be used in the compound and be equally as suitable as, and defy detection from, the genuine Para.

Apart from the fact that this is not true, and that it is only

another means of throwing dust in the eyes of the prospective buyer, it is worthy of notice only in that it is an acknowledgment by inference of the deceptive practice adopted by those putting forward the argument.

In this connection it is not out of place to mention still another fallacious argument used, and that is that the compound is improved by the addition of reclaimed rubber or rubber substitutes, or both. Of reclaimed rubber, Weber says: "The extracted rubber will now be found to have lost almost all its plasticity, elasticity and tensile strength, and to consist of a more or less cohering aggregate of crumbs of vulcanizer rubber possessing neither plasticity nor tensile strength;" and of fatty substitutes, "they reduce the quality of an India rubber article exactly in proportion in which they are present in the article, and the justification of their use lies purely in the popular demand for cheapness."

This seems pretty conclusive evidence of the ruinous effect of the introduction of such material, apart from the knowledge gained in actual experience that the use of inferior grades, or a mixture of inferior and good grades of rubber, or of rubber substitutes, lessens the life of the compound in proportion to the amount introduced.

Having outlined a means of determining high grade rubber insulation, it only remains to add that the most important thing of all, after having drawn up rigid specifications on the lines suggested, is to see that the tests are all made and complied with in every particular.—Railway Master Mechanic.

The New C. & N. W. Ry. Terminal at Chicago

The new Chicago terminal station of the Chicago & North-Western Railway, to be completed in the near future, faces south on Madison street, and is situated between Canal and Clinton streets.

Plans for this work were started in December, 1905. Construction on the approaches was begun in September, 1908, and work on the station building was begun in November, 1908.

Station Building.

The main building is a four-story structure of the early Italian Renaissance style of architecture, with a lofty Doric portico at the Madison street entrance, supported on a colonnade of six granite columns, each seven feet in diameter at the base and 61 feet high. Immediately back of this colonnade, entered by three great arches, is a vaulted vestibule, 132 feet wide, 22 feet deep and 40 feet high. At each end of this vestibule are broad granite stairways to the main waiting room on the track level floor. Similar vestibules of simpler architectural treatment give entrance from Canal and Clinton streets. These vestibules lead directly to a large public space, 200 feet by 92 feet, around which are arranged, in the most convenient manner, the ticket office, baggage room, lunch room, news stand, telegraph offices, parcel check room, etc. From the center of this public space the grand stairway leads to the concourse of the main waiting room on the track floor.

The main waiting room, which is the principal architectural feature of the station, is treated as a great Roman atrium, with a barrel vault roof. The pilasters and entire order up to the spring of the vault are a dull finished light pink Tennessee marble. The columns standing free are of Greek Cippolino marble, whose delicate green hue harmonizes perfectly with the greenish bronze of the metal work framing the glass between the pilasters. The vault is of ornamental tile construction with richly ornamented ribs of terra cotta of a color to harmonize with the marble of the walls.

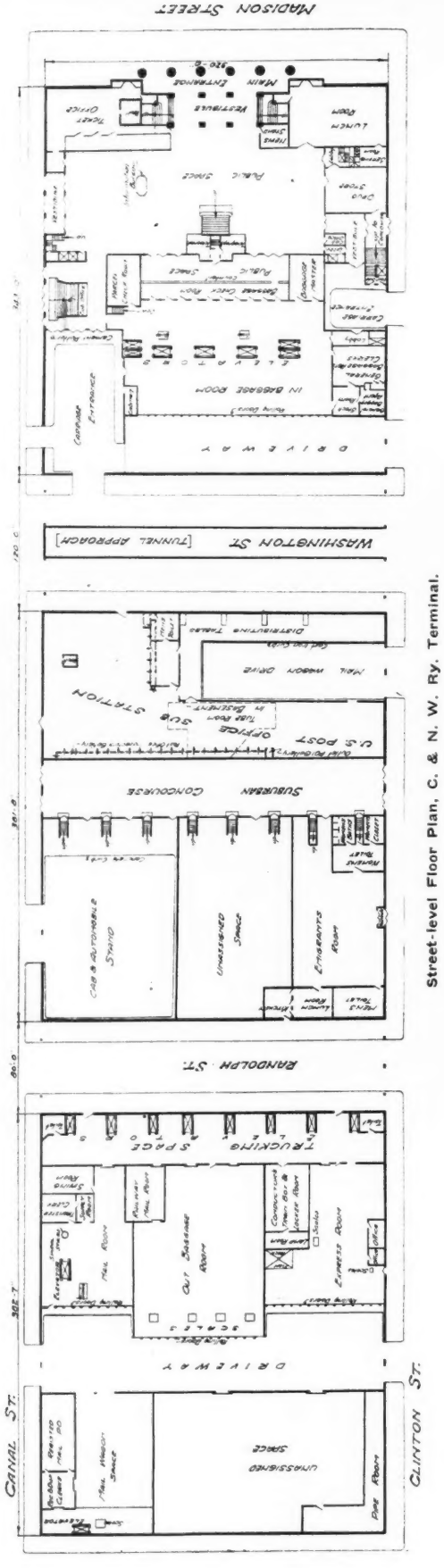
This great waiting room is directly lighted by two semi-elliptical windows, 60 feet in diameter, at either end of the vault and 10 semi-circular lunettes piercing the vault five feet on each side. It is also arranged to be lighted artificially by reflected light. Arranged conveniently around this main waiting room are the dining room, women's room, smoking room, barber shop, etc.

The exterior walls of the building are of gray Maine granite and are continuous with the enclosing walls of the train shed, which are of mottled gray brick, with granite trimmings. The train shed walls rise to a height slightly greater than the roof of the train shed, which gives the entire station the external appearance of one mammoth building.

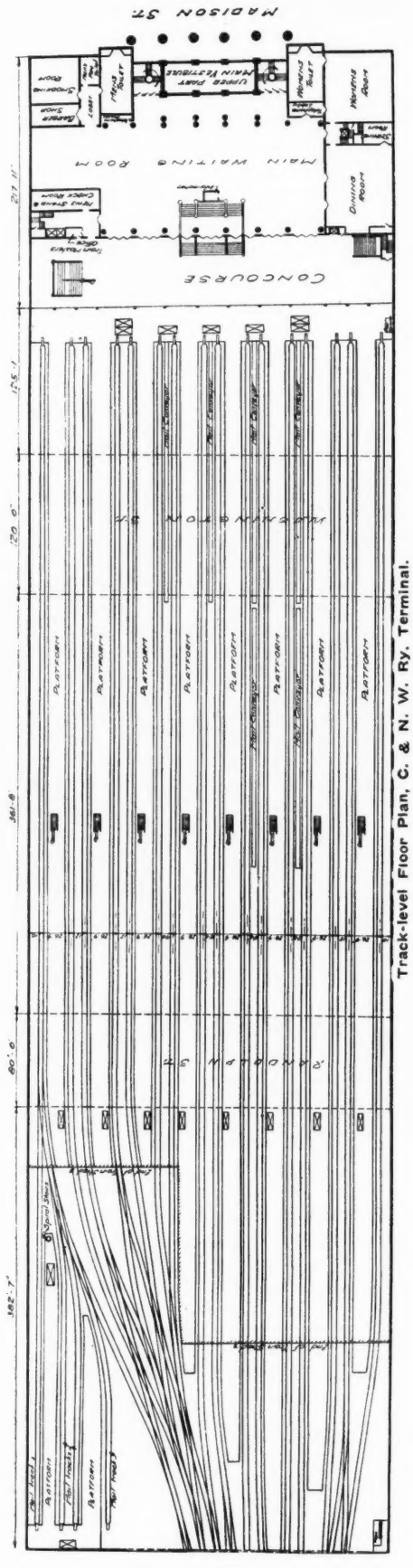
C. & N. W. Ry. Terminal Station.

The rooms on the first floor (street level) are: Ticket office, lunch room, serving room, drug store, news stand, telegraph offices, telephone booths, parcel check room, baggage check room, baggage room, baggage master's office, general baggage agent's office, baggage clerks' room, baggage stock room, baggage driveway, carriage concourse (public), carriage concourse (private) and public space.

The second floor is on track level and consists of the following: Main waiting room, dining room, serving room,



Street-level Floor Plan, C. & N. W. Ry. Terminal.



Track-level Floor Plan, C. & N. W. Ry. Terminal.

women's room, women's toilet, men's toilet, men's pay toilet, smoking room, barber shop, news stand and check room, telephone lobby and concourse.

On the third floor are the following rooms: Division superintendent's offices, assistant superintendent's offices, train dispatchers' office, division engineers' offices, clerks' offices, building superintendent and superintendent of clerks' office, filing rooms, chart rooms, blue print room, men's toilet room, women's retiring room, women's lavatory, women's toilet, tea rooms, serving room, emergency rooms, matron's room, barber shop, bath and toilet rooms and lounging room.

The rooms on the fourth floor are: Conductors' rooms, conductors' locker room, telephone exchange, electrical engineer's office, electrical engineer's laboratory, electrical engineer's clerk and file room, Pullman Company's office, time inspector's office, men's toilet and women's toilet.

In the basement are the following rooms: Kitchen, butcher shop, refrigerator room, store rooms, women employes' locker room, women employes' toilet room, women employes' rest room, baggage employes' locker room, station employes' locker room, public toilet, baggage store room, boiler room, fan room, switchboard room, engineer's office and general space.

The railway tracks enter the train shed about 15 feet above the street level. The tracks and flooring are supported on steel columns; beneath the tracks and between Washington Boulevard and Randolph St., are the following: United States post office sub-station, mail distributing platform, mail wagon driveway, mail employes' lounging room, men's toilet, suburban concourse, cab and automobile stand. Emigrants' quarters, waiting room, women's toilet, women's bath, men's toilet, lunch room, kitchen, and unassigned space.

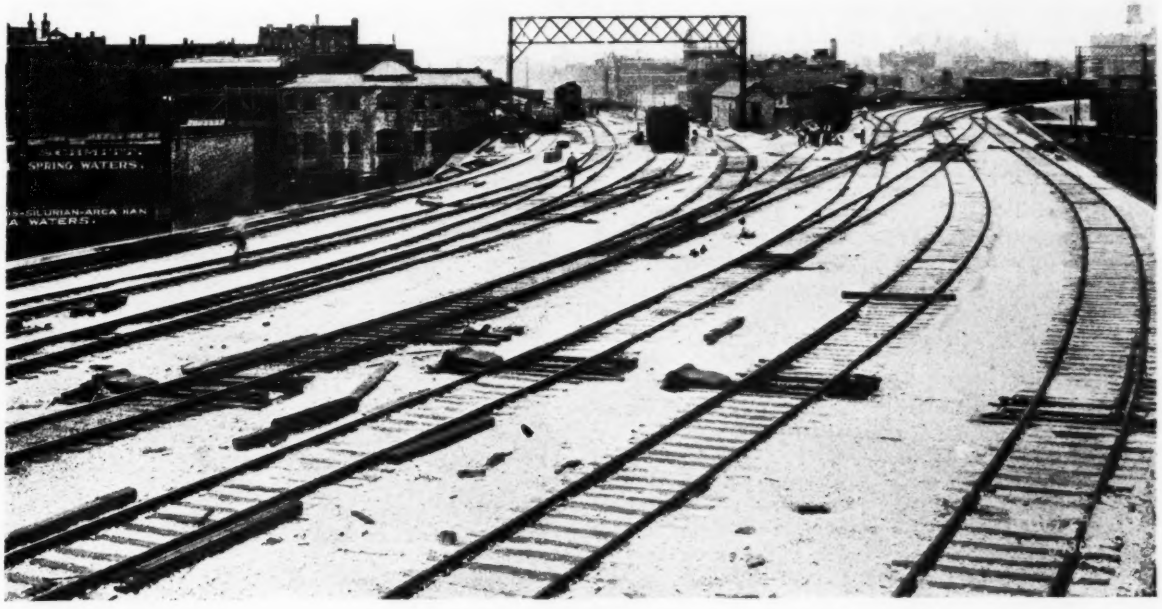
Beneath the track structure between Randolph and Lake Sts. are: Trucking space, outgoing baggage room, railway mail room, express room, express office, conductors' train box and locker room, lamp room, outgoing mail room, transfer clerks' room, supply room, mail employes' lounging room, toilet rooms, express, baggage and mail driveway, registered mail post office, receiving and dispatching clerks' room, pipe room and unassigned space.

Baggage and mail are to be handled on the lower floor. Electric and hydraulic elevators large enough to accommodate the largest baggage trucks have been provided. These elevators are so arranged that very little wheeling will be necessary on the platforms at track level, and baggage trucks need never be wheeled on the part of the platforms used by passengers.

Power House Equipment.

The boiler plant equipment consists of six "B. & W." water tube, vertical header type boilers, set two in battery, 800 horsepower each, built for 200 pounds working pressure. Boilers are set with combination of horizontal and vertical passes, and fired at mud drum end. Each boiler is equipped with superheaters of the Foster type. Green traveling chain grate stokers are provided for each boiler.

The coal and ash handling plant consists of Peck continuous, pivoted, bucket conveyors for handling both coal and ashes. Pan type conveyors are to be used for conveying coal from cars to the pivoted bucket conveyor, and an inclined pan type conveyor is used for conveying ashes to the ash storage bins.



Junction of Wisconsin and Galena Divisions, C. & N. W. Ry.

There are three vertical, cross-compound, non-condensing Allis-Chalmers Corliss engines, 25 inches and 44x42 inches, 1,150 i. h. p. at 100 r. p. m., with steam pressure at 155 pounds and 70 deg. F. superheat. The engines are arranged for direct connection to dynamos. Space has been left for an additional engine and dynamo unit of the same size as above.

There is one Curtis low pressure steam turbine and generator unit, 500 kw. capacity, 250-volt, D. C., 1,500 r. p. m. Space has been provided for an additional turbine and generator unit of the same capacity as above.

The electrical machinery consists of three direct connected, 100 r. p. m., 750 kw., 250-volt, continuous current, compound wound General Electric dynamos, each directly connected to a Corliss engine. Provision has been made for an additional 750 kw. direct connected generator. Also there are two motor generator sets, each comprising 250-volt D. C. motors, 720 r. p. m., driving a 500-kw., 6,600-volt A. C. three-phase, 60-cycle generator, each with its own direct connected exciter unit, and one 3-wire balancer set, capacity to care for 300 amperes unbalanced load. The switchboard will

Train Shed Construction—Interior View.

be located on a gallery at the south end of the building and will be equipped with a bench board for the electrical control of all main line switching devices, electrically operated motor starters and speed regulators, and electrically operated field rheostats; also with momentary contact switches for operating automatic solenoid switches which control station lighting. The board will also be equipped with all regulating and controlling devices for the circuits leading to the terminal station building.

The condensing apparatus consists of one Worthington 4,000 square foot condensers complete, with steam driven, dry vacuum air pump, with motor driven centrifugal hot well and circulating pump; and one roof type cooling tower equipped with four motor driven fans.

There are two outside, center packed Epping-Carpenter boiler feed pumps, duplex and compounded, size 8 inches and 12x7x12 inches. The feed water heater is a 3,000 horsepower Webster open type feed water heater.

The air compressors, two in number, are imperial type Ingersoll-Rand, two stage, with cross-compound steam ends, each of capacity sufficient to compress 500 cubic feet of air per minute to 100 pounds pressure, and each equipped with intercooler and the system provided with aftercooler.

In connection with the heating for power house and Lake street interlocking tower, there are two Marsh 6x8 inch vacuum pumps.

There is one Yeomans electric bilge pump and one Shone ejector for draining the power house basement. A gravity

Train Shed Roof Construction.

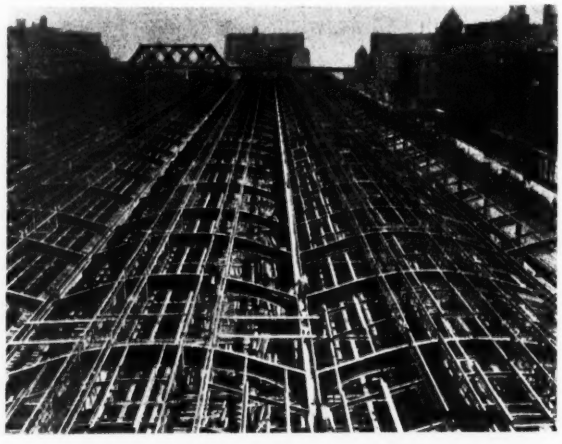
oiling system is provided, which supplies oil to all machinery in the power plant.

The chimney has a 11-foot internal diameter at base and 10 foot 6 inches internal diameter at top; it stands 245 feet above the boiler room floor and 227 feet above the street and is constructed of Custodis radial brick. Lighting rod protection is provided, consisting of four points, with 24 inch platinum tips and two 7/8 inch stranded copper conductors with copper ground plates and lightning indicator device.

The present power plant has a generating capacity of 2,750 K. W. H. The completed plant will have a capacity of 4,000 K. W. H.

Power Plant—Station Building.

The power plant consists of two "B. & W." vertical header type water tube boilers set in one battery, each 150 H. P. These boilers are set with twin fire furnaces. The equipment is as follows: Motor-driven centrifugal pumps for house service; return tanks and vacuum pumps for heating system; plunger pumps for delivering returns back to power house; garbage destructor; machinery for vacuum sweeping system; apparatus for temperature regulating system; ventilating fans; receiving and distributing switchboard; two 3-wire balancer sets, each to care for 600 amperes unbalanced load; underwriters' 1,500-gallon pump for emergency



Top View of Train Shed, Partially Constructed.

fire service; water heating tank for domestic supply; Carbondale Machine Company's absorption system refrigerating plant, capacity 50 tons; two high duty 3-cylinder compound crank and fly wheel pumping engines for elevators, size 13 inches and 16 inches by 3⅞ inches by 18 inches; two auxiliary duplex and compounded plunger pumps for elevators, size 10 inches and 16 inches by 3⅞ inches by 15 inches; two duplex pilot valve pumps for elevators, 7½ inches by 4½ inches by 10 inches.

The new track layouts for the terminal necessitate the construction of five new interlocking plants. These plants have not been completed, but work on them is being pushed. The interlocking and automatic signals are of the all-electric type.

For the Lake street plant at the entrance to the station yard, there are 171 levers in the tower:

67 levers for signals (dwarfs).
29 levers for single switches.
46 levers for double slip switch-points.
23 levers for movable point frogs.
6 levers to govern traffic.

171 working levers and 37 spare spaces.

In the station yard interlocking, the short track section

has been used. The use of this system makes it possible for the tower man to follow up a train closely and line up an opposing route by sections. The signals for this opposing route, however, remain locked at danger until the train has completely cleared the opposing route. This method saves a great deal of time, especially where twenty or more levers must be thrown to line up a route. If the levers are properly operated, the tower man will have only one, or possibly two or three, levers to manipulate after the first train has cleared the opposing route, and the second train may proceed immediately when the first train has cleared.

There are to be four other new interlocking plants, i. e., Clinton street, at the junction of north and west approaches; Carpenter street, at the entrance to Erie street coach yard; Division street, at the connection of the north approach with the Wisconsin division tracks; Noble street, at the connection of the west approach with the Galena division tracks.

Clinton Street Tower.

29 levers for high signals.
33 " " dwarf signals.
26 " " switches.
12 " " double slip switch ends.
6 " " movable point frogs.
35 " " derails.
14 " to govern traffic.

Total....155 working levers and 13 spare spaces.

Carpenter Street Tower.

8 levers for high signals.
15 " " dwarf signals.
7 " " switches.
8 levers for double slip switch ends.
4 " " movable point frogs.
13 " " derails.
6 " to govern traffic.

Total.... 61 working levers and 15 spare spaces.

Division Street Tower.

12 levers for high signals.
19 " " dwarf signals.
25 " " switches.
6 " " double slip switch ends.
3 " " movable point frogs.
17 levers for derails.
6 " to govern traffic.

Total.... 88 working levers and 32 spare spaces.

Noble Street Tower.

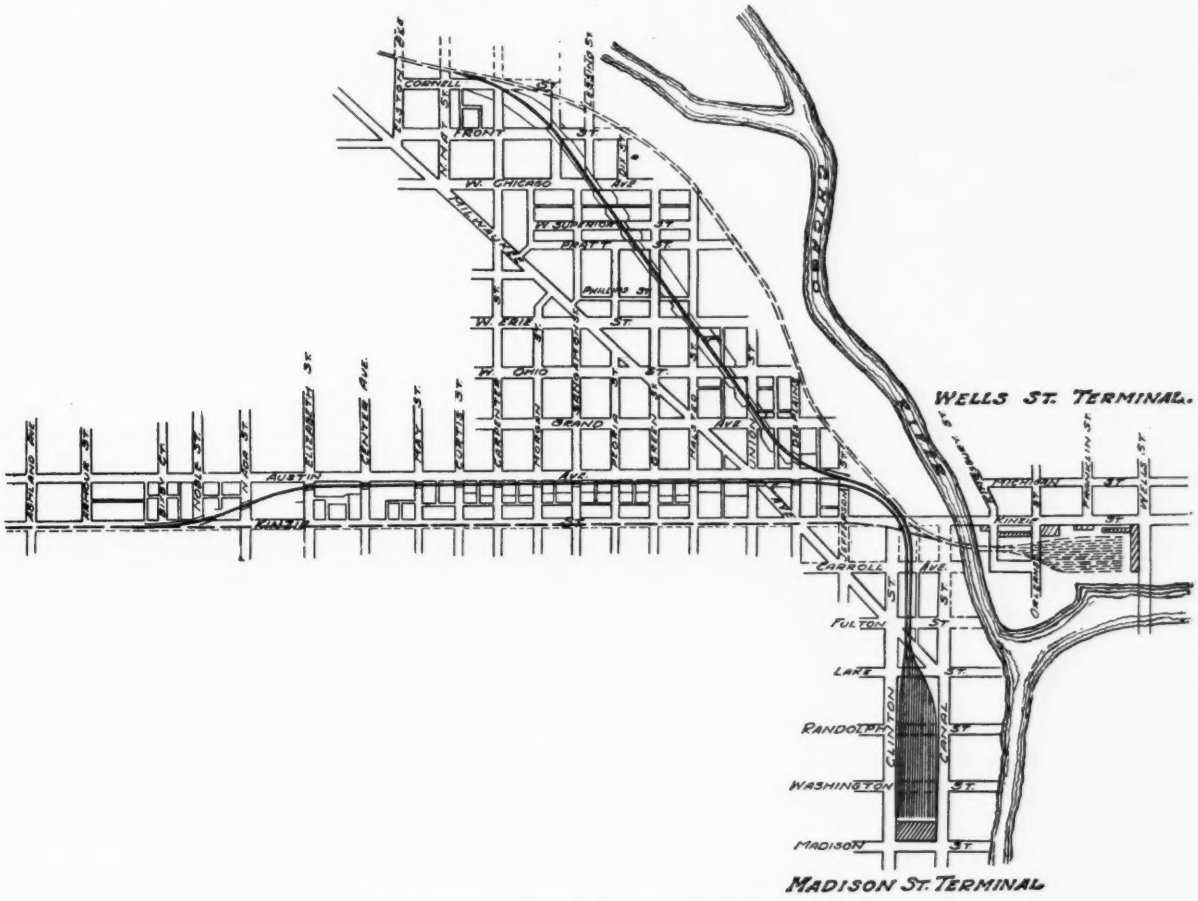
10 levers for high signals.
11 " " dwarf signals.
7 " " switches.
8 " " double slip switch ends.
4 " " movable point frogs.
11 " " derails.
4 " to govern traffic.

Total.... 55 working levers and 25 spare spaces.

Seventeen automatic signals in addition to the interlocking signals used as automatics.

Summary.

204 levers for signals.
94 " " switches.



Map of Chicago Terminal Territory, C. & N. W. Ry.

Terminal Power House, C. & N. W. Ry.

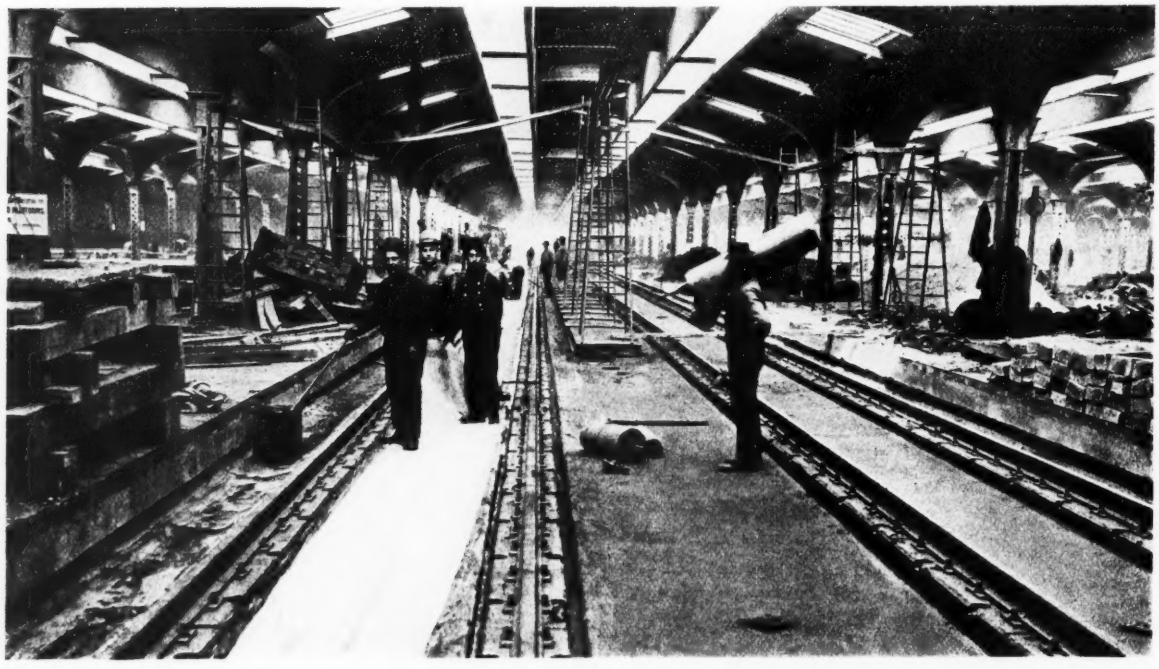
80 levers for double slip switch points.	
40 " " movable point frogs.	
36 " " governing traffic.	
76 " " derails.	
530 working levers.	
122 spare spaces.	
Total	652

Areas, Dimensions, Etc.

Area of station building, 320x218 ft.	69,760 sq. ft.
Area of station yard, 320x1,072 ft.	343,040 sq. ft.
Area of train shed roof	265,800 sq. ft.
Area of right-of-way acquired	37 acres
Area of right-of-way covered with buildings	20 acres
Buildings wrecked or moved	455
Buildings wrecked or moved (4 stories and over)	66
Number of tracks in station yard	16
Total length of yard tracks, 14,330 ft., capacity	200 cars
Length of shortest yard track, 610 ft., capacity	9 cars
Length of longest yard track, 1,325 ft., capacity	18 cars
Number of tracks in station approach	6
Number of passenger platforms	8
Width of platforms	16 ft. 9 in.
Aggregate length of platforms	7,160 ft.
Number of streets bridged	40
Number of alleys bridged	13

Quantities of Work.

Excavation		250,000 cu. yds.
Piles driven, 43,000		1,530,000 lin. ft.
Concrete		265,000 cu. yds.
Structural steel in station and street viaducts		37,000 tons
Waterproofing		665,000 sq. ft.
Tracks: North approach	33,500 ft.	
West approach	26,700 ft.	
Terminal section	34,500 ft.	
Total	94,700 ft. =	18 miles
Single switches		82
Lap switches		4
Double slip switches		39
Crossings		6
Curbing		22,000 lin. ft.
Cement sidewalk		226,000 sq. ft.
Paving		42,800 sq. yds.
Caissons under station building		172
Caissons under walls of Washington street tunnel		36
Caissons under Lake street span		4



Interior View of Train Shed During Waterproofing Operations, C. & N. W. Ry.

Caissons under chimney.....

Ninety-three of the caissons under the station building and those under the chimney extend to rock, approximately 120 feet below street level. All other caissons are founded on hard pan, approximately 85 feet below street level.

Approximate Cost.

Real estate and legal expenses	$11,560,000.00
Station building and train shed	6,380,000.00
Power station, building and equipment	810,000.00
Elevated approaches	5,000,000.00
Total	$23,750,000.00

Chronology.

Began studies on general plan	December,	1905
Began work on detail plans	November,	1906
Began wrecking buildings	November,	1906
Began raising Oak Park Elevated R. R.	June,	1908
Began construction work on approaches	September,	1908
Began construction work on station building	November,	1908
Began erecting steel work	February,	1909

The new right-of-way acquired was held largely by manufacturing concerns, and was quite near the center of Chicago. It is probable that few railroads would have attempted to buy property as valuable. Much of the property had to be acquired through condemnation proceedings, and these proceedings caused many delays.

The track changes were made without delay to traffic, and the prevailing policy in all the work was not how cheap, but how good. The expensive manganese steel frog has been used almost exclusively. All switches were of the latest and most approved design.

The general design of the terminal shows a careful analysis of and wise provision for future increased traffic, and it will doubtless be many years before the present terminal will be worked to its full capacity.

The new Chicago terminal is a fitting monument to the push, progressive spirit and engineering skill of the officials of the Chicago & Northwestern Railway—a monument of which the great and growing city of Chicago may be justly proud.

The Signal Department

STATED MEETING OF THE RAILWAY SIGNAL ASSOCIATION.

The stated meeting of the Railway Signal Association will be held at the Congress Hotel, Chicago, March 20th. At the forenoon session reports of committees will be considered, the principal feature being a discussion on symbols (12 cuts), and a report on specifications for alternating current signaling. It is understood, however, that all other committees will make verbal reports. The afternoon session will be devoted to two papers, "Portable Storage Batteries for Automatic Signal Work as Used on the Harriman Lines," by Mr. A. H. McKeen, signal engineer, O. W., R. R. & N., and "Alternating Current as Applied to Railway Signaling," by L. F. Howard, of the Union Switch & Signal Co.

The Buffalo, Rochester & Pittsburgh has ordered from the General Railway Signal Co., Rochester, N. Y., three position, upper quadrant, semaphore, automatic block signal material for 35 miles of double track from Clarion Junction, Pa., north of Johnsonburg, to Falls Creek, Pa.

RAILWAY SIGNAL STANDARDS NO. 16. THE ERIE.

The Erie has automatic block signals working both on the normal danger and normal clear systems. Until recently all signals worked in the lower right hand quadrant, 60 deg., giving indications in two positions; more recently however, upper quadrant, three position signals have been installed.

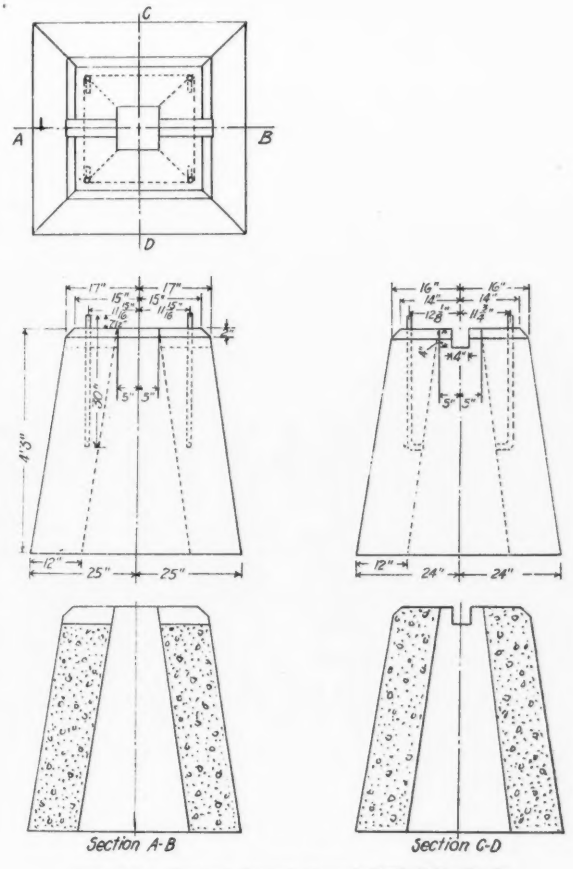


Fig. 376. Typical Signal Foundation, Erie R. R.

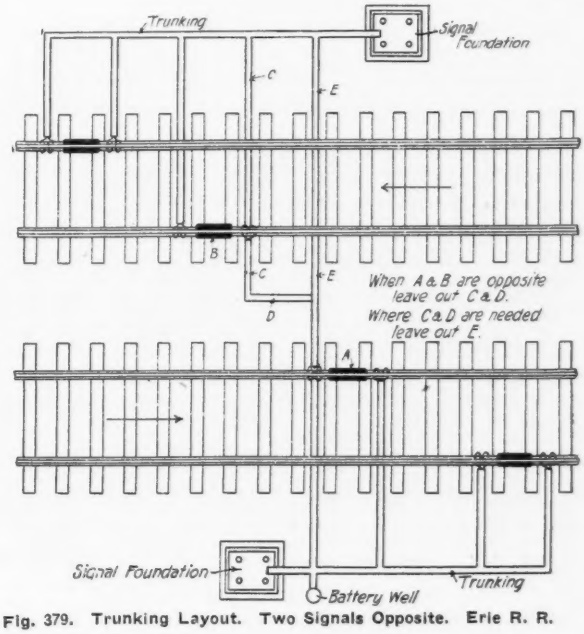


Fig. 379. Trunking Layout. Two Signals Opposite. Erie R. R.

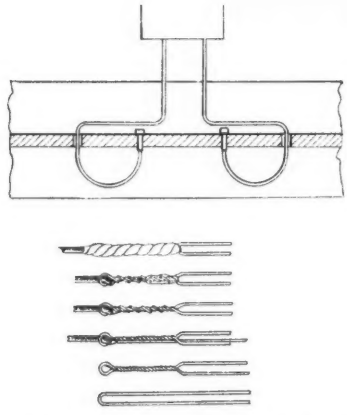


Fig. 377. Wire Connection from Bootleg to Rail, and Method of Making Joint. Erie R. R.

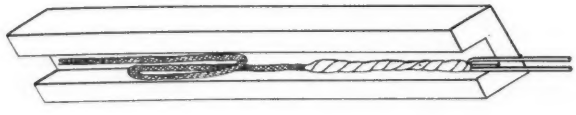


Fig. 378. Detail of Bootleg. Erie R. R.

Lower quadrant spectacles are similar to that shown in Fig. 149, upper quadrant spectacles are according to R. S. A. standard. The signal itself, electric motor type, is like that shown in Fig. 59, two arms being generally used with lower quadrant signals. Night color indications are as follows, red for stop, yellow for caution, green for clear. Micronisms are placed at the bottom of the post. Electro-gas signals, very similar in appearance to that shown in Fig. 59, are used to a considerable extent.

Signal operating battery consists of caustic soda or storage cells housed in concrete wells, cases at base of post, or wooden boxes. Storage battery is charged from a power line, fed by generators driven by gasoline engines. Track battery consists of 2 or 4 cells of gravity housed in iron or fibre chutes. The same battery operates the signals and feeds line circuits. The length of block varies from 1,500 ft. to 7,200 ft.

Both separate line circuits and the polarized track circuit are used to control the distant indication, Fig. 142. For normal danger signals a differential circuit similar to that shown in Fig. 104 is used. Overlaps are not used. There are a few Herrington automatic train stops in use.

A separate pole line for signal circuits is not used, line wires are strung on the same poles as the telegraph wires. Common return is not broken.

Wire ducts consist of wooden trunking placed both above and below ground. Fig. 379 shows a typical trunking layout and Figs. 377 and 378, details of bootleg. Fig. 376 shows a typical concrete foundation. Note the saving in material effected by making it hollow.

Switch indicators of the semaphore type are used in connection with normal danger signals on the New York division, but not on new work.

The following sizes and classes of wire are standard: for bootlegs, No. 6 B. & S. gage copper clad steel; for leads from track and battery, No. 9 B. & S. gage rubber covered copper; for leads from line, No. 14 B. & S. gage rubber covered copper; in chutes, No. 12 B. & S. gage rubber covered stranded copper; for line No. 12 B & S. gage copper.

Track relays are of 4 ohms resistance and meet R. S. A. specifications.

THIRD ANNUAL REPORT OF THE BLOCK SIGNAL AND TRAIN CONTROL BOARD TO THE INTERSTATE COMMERCE COMMISSION.

(Continued.)

Monographs.—A majority of those who have presented devices to the board for examination have manifested such unfamiliarity with actual railway operating conditions that it has seemed proper this year, at least, that the board should set forth certain principles of correct design and construction of some forms of railway equipment, appliances, and structures, with a view to showing the present state of the art in such matters and of directing effort along right lines. With these objects in view, the board has had prepared monographs on the following subjects:

(1) The Principles and Mechanical Development of Train Control Apparatus for Steam Railroad Service.

(2) The Car Wheel.

(3) The Electric Track Circuit.

These monographs will appear as appendices to this report. They set forth the state of the art and the principles that must be observed in the development of devices pertaining to each particular field, as well as economic and other considerations that have to do with the practicability of safety devices in actual service.

The monograph on train brakes is by Mr. Walter V. Turner and Mr. S. W. Dudley, both connected with the Westinghouse Air Brake Company. These gentlemen were chosen for this work because of their reputation as engineers and their familiarity with the history of the development on the brake since it was first introduced forty years ago. It was particularly requested of them that the article should be written from the viewpoint of the engineer, carefully avoiding any commercial aspects.

Train-dispatching system.—The board has examined a number of devices which are intended to be used as adjuncts to the train-order or dispatching system, and designed to render station operators less liable to forget or neglect to deliver orders to train crews. While these devices in the hands of faithful and conscientious operators, striving to the best of their ability to avoid error, would probably serve a useful purpose in the handling of train orders under the time-interval system, and to that extent can be recommended, it is important to bear in mind that they do not cure, and, indeed, do not profess to cure, all the dangers of the train-order system. The board regards all dispatching systems which depend on the use of clocks and watches, on minimum time intervals between trains, and on written orders of various forms transmitted by telegraph or telephone, to be read and comprehended or interpreted by trainmen, as being so far inferior to the block system or space interval that it is not disposed to recommend the use or extension of any such dispatching system in preference to the block system. In other words, the weaknesses of the dispatching system are so complicated and perplexing that the only comprehensive means of dealing with them is the adoption of the space interval or block system, and the board can not countenance any improvement in a single feature of the dispatching system without at the same time emphasizing the fact that the system as a whole still remains defective.

A B C system.—The A B C system of block signaling, which has been in use on the Northern Pacific for about three years past, and an account of which was given in our

last annual report, page 31, has been abandoned on all but one of the divisions where it was in use, and it is to be abandoned entirely. It was introduced on a short section of the line east of Spokane, Wash., in the autumn of 1907; and the success which attended its use on that section led to its extension to the whole of the division and subsequently to other divisions, making an aggregate length of 681 miles of road on which the system was worked. Following a change of officers of the operating department, it was discontinued on the division east of Livingston, Mont., February 27, 1910; and on the lines west of Cheney, Wash., it was discontinued in August. On the remaining divisions, Paradise to Cheney, 204 miles, the change is about to be made.

The interest which was taken in this system by railroad officers generally was largely due to the increased safety secured by means of it as compared with the method, common on single-track railroads, of conferring on trains the right to the road by means of time tables, dispatchers' orders, etc.; and it was in relation to the efficiency of the system as a means of safety—that is, of preventing collisions—that it was considered by this board. It appears, however, that its adoption on the Northern Pacific was largely because of the economy thereby secured in the movement of freight trains, and the reason given by the officers for going back to the old system is that, although in the use of the A B C system they secured the advantages expected, so far as freight trains were concerned, there was a disadvantage in that important fast passenger trains were delayed.

The board has not had opportunity to make a thorough inquiry concerning the situation since it was advised of this change; but a letter from an officer of the road indicates that this delay of passenger trains, together with some inconveniences when line wires were broken or otherwise unavailable for use, was the reason for changing.

As the movements of all trains are under the immediate direction of a dispatcher, who has absolute authority throughout his division, it is not clear how freight trains should be unduly favored as compared with passenger trains, except as the dispatchers themselves ordered, or at least approved, such favoring.

Where the A B C system has been discontinued, the company has equipped the line from Billings to Livingston, Mont., 116 miles, with automatic block signals. On that part of the line from Cheney to Auburn, 361 miles, the simple manual block system is used. The manual block system will also be used on the line between Paradise and Cheney, 204 miles, when the A B C system is discontinued on that section.

The Block System.

In its report to Congress of February 23, 1907, on block-signal systems and appliances for the automatic control of railway trains, the Commission indicated the need for investigation under four heads, as follows:

(1) The telegraph block system on the larger roads (mainly double track) as regards the personnel and the routine, the use or nonuse of distant signals, and the practice of permissive blocking.

(2) The telegraph block system on single track lines and minor roads as regards the personnel, the routine, distant signals, and permissive signaling, and also as regards the use of time rules and dispatchers' orders to make up for incompleteness in the block signaling arrangements.

(3) The automatic block system should be investigated on all roads with respect to the efficiency of the apparatus and of the methods of inspection and care, and the integrity of the records of signal operation in respect to their completeness.

(4) The automatic block system on single track lines should be investigated with respect to the features named in paragraph 3, and also as regards the use simultaneously with the block signals of dispatchers' orders and other measures designed to prevent collisions irrespective of the block system.

The work of investigation under these heads was begun by the board during the latter part of 1908, and the results obtained were set forth briefly in its last annual report. This work has been continued and extended during the past year, and the results have been briefly summarized and are published as Appendix E to this report.

It will of course be understood that the investigations thus far conducted have not been complete; facilities have been inadequate to permit an exhaustive examination of the problem in all its details. Enough has been learned, however, to make it apparent that the block system, both manual and automatic, on most American railroads, is operated far below its maximum efficiency. The most crying present need is reformation in both personnel and methods of operation. For the safe operation of the manual block, competent and faithful signalmen are absolutely essential. With first-class men, objectionable methods of operation or maintenance may be tolerated without unduly sacrificing safety; but with incompetent or unreliable men even the best methods do not insure safety, no refinement in apparatus or system of rules being sufficient to overcome the weakness due to inexperience, slovenly mental habits, poor training, or lack of proper moral qualities.

The board, in all its preceding reports, has indorsed the recommendation of the Commission to the Congress that legislation looking to the compulsory adoption of the block system be enacted. It has not hesitated to do this, because the art of block signaling is well settled. At the present time only about 66,000 miles of railroad out of a total of approximately 240,000 miles in this country is operated under the block system, notwithstanding the superabundance of evidence that the system has added immeasurably to safety in railway transportation. The situation is not unlike that which existed at the time the adoption of car couplers and power brakes was compelled by federal enactment. Extensive experiments, supplemented by experience, the good results of which have been universally recognized, have clearly shown a simple course for legislation to take. The introduction of the block system will tend to reduce the collision record in a very decided measure. The board believes so firmly in the advantages to be derived from the use of the block system that it desires again to urge the recommendation of the Commission to the Congress for compulsory legislation requiring its use as the step of foremost importance in promoting safety in railway operation. Relatively inexpensive and simple block systems can, by proper attention to training and discipline of signalmen, be operated with a high degree of success.

The facility with which the space-interval principle can be adopted and put in use on a railroad is well illustrated by the action of the Baltimore & Ohio Southwestern in July last, when the line of that company from Storr's, O., westward to Vincennes, Ind., and from North Vernon, Ind., to New Albany, over 180 miles, was equipped with all the necessary apparatus for the operation of the simple manual block system in less than one week. Sixty-two offices were equipped with telegraph instruments and batteries. Those who were disposed to look upon this as an extraordinary performance should bear in mind that not much apparatus is required. In this case a new telegraph wire, for use in signaling from one block station to another, was put up the whole length of the line. The wire was strung on the poles of the existing telegraph lines. For some of the block stations the regular station telegraph office afforded with its telegraph apparatus and train-order signal the necessary facilities. In order to arrange the block sections so that

they should be of approximately uniform and not excessive length, a number of new block stations had to be established between the regular stations and, aside from the stringing of the new telegraph wire, this was the principal work that had to be done. To facilitate the movement of freight trains waiting on long side tracks where the engine of a waiting train could not be near the station, telephones were put in at the remote ends of these side tracks and connected to the station office.

While at most of the places on the line in question the switches are not interlocked and signaled, the arrangement, with suitable regulations, does nevertheless provide a good degree of protection for the movement of the trains. The principal element which has to be considered by the railroad company in a change of this kind is the increase in the pay rolls necessitated by the establishment of new block stations, each of which must be manned by three men (to cover the twenty-four hours of the day) and by the employment of night telegraphers at some of the stations which before were manned only in the daytime.

So fully is the board convinced of the adequacy of a simple manual block system, properly worked, materially to reduce the large number of collisions which now occur under the time interval and dispatching system that it believes that any legislation compelling the use of the block system should be confined to the broad fundamental principle, so as to leave the railroads the greatest possible freedom in the adaptation of the means to be employed to meet the needs of their service.

Automatic Stops.

Since its organization the board has examined plans and specifications of 149 signal and automatic train-stop devices. Of this number only 16 purely automatic-stop devices have been considered to possess sufficient merit to warrant the board in offering to test satisfactory installations. The devices thus approved, with statements of their present status, are as follows:

(1) Charles E. Duffie, Omaha, Neb. Approved for test Feb. 22, 1908. This is a cab signal and train stop making use of intermittent contact rails. The inventor submitted circuit plan for a proposed installation on the Union Pacific Railroad early in 1910, and stated that he was negotiating with the company for permission to make an installation which would be satisfactory to the board for the purposes of official test. Under date of Nov. 5, 1910, Mr. Duffie informed the board that these negotiations have been successfully concluded and officers of the Union Pacific have given definite orders to make the installation about 40 miles west of Omaha on the main line of the road. Mr. Duffie states that the installation will consist of four signaling points and that two high-speed engines in regular service will be equipped with his cab signal and train-stop apparatus.

(2) A. L. Bower, Boyertown, Pa. Approved for test July 20, 1908. This is a cab signal and automatic train stop, requiring short sections of insulated track rails and the insulation either of a truck from the remainder of the locomotive or of the locomotive from the tender. Permission was secured from the Philadelphia & Reading Railroad to make an installation on that road at the expense of the inventor. Up to date the installation has not been completed, and the board is not aware of any present activity on the part of the inventor looking toward that end.

(3) G. W. Jayne, Washington, D. C. Plans tentatively approved July 20, 1908. This is a cab signal and train stop making use of Hertzian waves, a "wireless" system. The device is designed on correct principles, and the proprietor was advised that his system possessed merit warranting its further development. Since the board's opinion on the above-described system was rendered, Mr. Jayne has submitted plans of another system which he regards as an improvement over the first. These plans cover a system working by induction rather than by Hertzian waves. The plans of this latter system are now under examination.

(4) Perry-Prentice Electric Company, Chicago, Ill. Approved for test July 20, 1908. This is a Hertzian wave or wireless cab signal and automatic-stop system. It has been installed on the Chicago Suburban Railroad (electric) and examined by the board. This installation was not considered suitable for a conclusive test. The board has been advised, under date of Nov. 8, 1910, by the Perry-Prentice Company that lack of capital alone has prevented them from making an installation for test purposes under conditions that would be satisfactory to the board.

(5) P. J. Simmen, Los Angeles, Cal. Approved for test July 29, 1908. This is a controlled manual block and automatic train-stop system employing intermittent contact rails. This system, without automatic stop, was installed and used on the Toronto & York Radial (electric) Railway, and was inspected by members of the board. No installation has as yet been offered in which the automatic stop was used, and the installation on the Toronto & York Radial Railway does not approximate service conditions on steam roads closely enough to warrant the board in conducting test of that installation. Mr. Simmen advises, in reply to a recent inquiry, that lack of capital has prevented him from providing such an installation as the board would consider satisfactory for test purposes. He estimates that an installation suitable for test by the board would cost from $15,000 to $25,000, because in order to demonstrate the remote control principle which is a prominent feature of his system it would be necessary to equip an entire division of some road. He advises the board that he has been in negotiation with the Pennsylvania Railroad Company for permission to make an installation on its Bedford division about 70 miles in length. These negotiations have not yet been successful for the reason, as Mr. Simmen states, that he and the officers of the road have not been able to come to a satisfactory conclusion on the matter of terms covering the cost, which it is stated will be about $12,600 at a minimum.

(6) Railway Electric Signal Company, New York, N. Y. Approved for test July 29, 1908. This is an automatic stop and cab signal of the intermittent contact rail type employing alternating current. It is understood that the proprietor has abandoned further effort on this system in favor of a system worked by induction rather than by electrical contact.

(7) H. D. Patterson, New York, N. Y. Approved for test Oct. 1, 1908. This is a cab signal and train-stop system in which electrical devices located along the roadway act inductively to produce effects upon apparatus located on the train or engine. In reply to an inquiry, Mr. Patterson states that he is now preparing for an installation suitable for examination by the board on one of the elevated lines of New York City. He also states that lack of capital has delayed the work of development.

(8) Rowell-Potter Safety Stop Company, Chicago, Ill. Approved for test Oct. 12, 1908. This is a ground mechanical trip automatic train stop and automatic block system combined. It was tested by the board during the winter and spring of 1908-9. (See second annual report.) The board has no information of any working installation of this system having been made.

(9) H. J. Warthen, Washington, D. C. Approved for test Nov. 2, 1908. This is an intermittent contact rail cab signal and automatic train stop. The device is now being installed on the Buffalo, Rochester & Pittsburg Railway, near Rochester, N. Y., for purposes of test.

(10) A. H. Fox, New York, N. Y. Plans tentatively approved May 27, 1909. This is an automatic train stop of

the magnetic or inductive type, depending for its operation on the nonmagnetic property of manganese steel rails. The inventor was encouraged to develop his system further, and now informs the board that he has secured the use of road and proposes to make an installation for the purpose tracks on the Putnam division of the New York Central of testing the operation of his device with a view to securing definite data regarding particular features; and that as soon as these data have been obtained he will be prepared to offer the board an installation for test purposes.

(11) Gray-Thurber Automatic Train Control & Signal Company, Guy P. Thurber, president, Pittsburg, Pa. Approved for test Oct. 21, 1909. This is a cab signal and train stop requiring short sections of insulated track rails, and the insulation either of a truck from the remainder of the locomotive or of the locomotive from the tender. This device is now being installed on the Lake Shore & Michigan Southern Railway, near Cleveland, O., for purposes of test.

(12) S. H. Harrington, New York, N. Y. Approved for test Sept. 15, 1909. This is an overhead mechanical trip automatic train stop. It was tested by the board on the Erie Railroad during the winter of 1909-10. (See Appendix D for results of test.)

(13) Darwin G. Jones, Atlanta, Ga. Approved for test Dec. 22, 1909. This is an intermittent contact-rail cab-signal and automatic train stop. The proprietors have made a preliminary installation on the Roswell branch of the Southern Railway near Atlanta. This installation has just been completed and has not yet been fully examined so as to determine whether or not it will be suitable for purposes of an official test.

(14) Electrical Automatic Railroad Safety Signal Company, Jacob A. Cantor, president, New York, N. Y. Approved for test May 28, 1910. This is called the Lacroix cab signal and automatic stop; it is an intermittent contact rail system. This device was installed and exhibited on the Erie Railroad, near Nutley, N. J., and has been examined by a member of the board. Plans of an installation which is now being made on the Staten Island Rapid Transit Railway have been filed with the board, and it is expected that this installation will be ready for official test during the coming winter.

(15) Ross Engineering Company, Chicago, Ill. Approved for test July 22, 1910. This is a cab signal and automatic stop, requiring short sections of insulated track rails at indication points, and the insulation of one truck from the remainder of the engine or of the locomotive from the tender. The board is not aware of any action yet taken looking toward an installation for test purposes, but is informed by the proprietors that the General Railway Signal Company, of Rochester, N. Y., is developing the Ross apparatus and intends to make an installation to test the merits of the system.

(16) Railway Automatic Safety Appliance Company, U. G. Glick, president, Wilmington, Del. Approved for test Sept. 21, 1910. This is a mechanical trip automatic train stop in which the trips are of intermediate height, or about the level of the buffer beam on the locomotive pilot. Exhibitions of the device have been made by the proprietors and witnessed by representatives of the board. The board is informed by the proprietors of this device that arrangements have been made with the Pere Marquette Railroad Company to make an installation for official test purposes and that work upon this installation is now in progress; it is expected to be completed, ready for inspection, about the middle of December.

It will be observed that only two of the above-mentioned systems, namely, the Rowell-Potter and the Harrington, have so far been fully tested by the board. The Gray-Thurber and the Warthen systems, as well as those of Electrical Automatic Railroad Safety Signal Company and the Railway Automatic Safety Appliance Company's devices, are now in process of installation, and it is expected that they will be fully tested during the coming winter.

In addition to these purely automatic stop devices, the board has approved for test the following cab-signal devices, to which an automatic train stop can be attached, if desired:

(17) E. F. Clement, Philadelphia, Pa. Approved for test Feb. 22, 1908. This is a cab-signal system designed to repeat in the engine cab the indications of fixed signals along the roadway, making use of short sections of insulated track rails and a truck insulated from the remainder of the locomotive, or the locomotive insulated from the tender.

(18) Railway Audible Signal Company (Ltd.), London, England. Approved for test Feb. 5, 1910. This is an audible cab signal requiring short sections of contact rail. The apparatus is electrically operated in connection with fixed signals. In operation, when the signals are clear, the contact rail is charged, causing a proseed indication to be displayed in the cab; when the signals are at stop, the circuit to the contact rail is broken, causing an audible danger indication to be given in the cab. The apparatus is in use on the Great Western Railway of England, and records of its service were given in the board's last annual report, page 22. The company states that it is now negotiating for an installation in this country for purposes of test.

As set forth in its first annual report the board has considered that as block signals, both automatic and nonautomatic, have already been intelligently developed in this country, particular attention should be devoted to the automatic stop, which has not been so fully developed.

Collisions resulting from the weaknesses in the time-interval or train-dispatching system, and the deficiencies in the block-system due to untrained or undisciplined signalmen, as well as errors on the part of enginemen and trainmen, have led to public demand for automatic devices. Many seem to believe that the introduction of the automatic-train stop would greatly diminish railroad collisions of all classes. While it is true that the use of automatic features in the block system itself, as a result of which block signals are actuated directly by the movements of the train, would greatly diminish the number of collisions due to errors in manual block working, the fact should be clearly borne in mind that the automatic stop corrects but one defect, namely, the failure of the engineman to observe, understand, and obey signal indications. It does not in any way insure that the indications displayed will be correct, nor in any way prevent collisions due to the inherent defects of the dispatching system nor to improper working of the block system. This, however, should not be construed as in any way minimizing the importance of the automatic stop, for it is a well-known fact that many accidents have been caused by the failure of enginemen to observe, understand, and obey signal indications. Failures to observe signals may be due to fog, snow, signal light not burning, or smoke from other trains; failure to understand or comprehend the signals may be due to complexity in the system of indications or to diversion of the engineman's attention or to his physical incapacity; failure to obey indications that are seen and comprehended are rare, and comprise only those cases where enginemen desiring to make time are tempted to take chances, or to a too liberal interpretation of rules which allow the enginemen some discretion. Experience with automatic stops shows that under proper discipline they perform a moral function in that runners are more careful to heed stop signals when it is certain that disobedience of such signals will be detected.

In the discussion of the first test of an automatic stop made by the board it was deemed desirable to present in-

formation which would enable a sound judgment to be formed not only of the merits of the device then tested, but also of other devices to be tested in the future. While certain automatic train-control systems may be superior to others of the same class, it may result that certain classes of systems, when properly developed, will be found far superior to others in the completeness of the protection which they afford. The board therefore formulated and published in its last report characteristics which it believed desirable in every system of automatic train control. These characteristics, with slight modifications in phraseology, and the addition of one other (No. 10), are as follows:

(1) The apparatus should be so constructed that the removal or failure of any essential part would cause the display of a stop signal and an application of the train brakes. If electric circuits are employed, they should be so designed that the occurrence of a break, cross, or ground, or a failure of the source of energy in any of the circuits would cause the display of a stop signal and an application of the train brakes.

(2) The apparatus should be so designed that it may be used on the open roadway, on bridges, or elevated structures, in tunnels or subways, and where either steam or electricity is used as the propelling power.

(3) The apparatus should be so constructed as to conform to recognized standards of clearance for rolling equipment and structures, so that those portions of the apparatus placed on the roadway will not be subjected to damage by rolling stock or engines, nor those portions placed on the vehicles be damaged by any structures permitted to exist on the roadway; and at the same time, all vehicle parts and roadway parts which may have to come into operative relation with each other should be so designed that proper operative relation will be assured under all conditions of speed, weather, wear of track or vehicles, oscillation, and shock.

(4) The system should operate under all weather conditions which permit the operation of trains.

(5) The system should be capable of control by the ordinary means used for indicating the condition of the block about to be entered, such as electric track circuit.

(6) The engine apparatus should be so constructed as to prevent release of brakes after an application has been made until the train has been brought to a stop, or the obstruction or other condition which caused the application has been removed.

(7) The system should be so designed that should operating conditions require it, speed control may be used; that is, provision made for a train to pass an automatic stop in tripping position without the application of the brakes, provided the speed is less than a predetermined number of miles per hour.

(8) The system should be so designed that when no cause for stopping a train exists, a definite and positive clear or proceed indication will be given at every point where a stop indication would be given or the brakes applied when adverse or dangerous conditions exist.

(9) The system should provide, at least for use under congested traffic, for a continuous display of indications rather than for their intermittent display at certain definite points, as of course is necessary with fixed signals.

(10) The apparatus should be so constructed and installed that it will not constitute a source of danger to trainmen, other employes, or passengers.

It is probable that other conditions may develop as the result of the use of automatic train-control systems which it will be found necessary to meet, and it is possible that experience will develop the necessity for a modification of some of the characteristics described.

Partly as a result of weeding out and discarding impracticable designs during the two preceding years, and partly, no doubt, as the result of study on the part of those devoting effort to the subject, some of the automatic stop devices examined during the past year have shown more intelligent care in their design and development, and have possessed meritorious features in a greater degree than was true of those previously examined. For this reason the board has been led to offer suggestions and more or less encouragement to a number of persons who are working to produce practicable automatic stops.

In its second annual report the board stated that the principal question to be dealt with in connection with automatic stops is that concerning their applicability to the varied conditions of general railroad traffic and their behavior under adverse weather conditions, and that the experience gained from the use of automatic stops on underground and elevated railroads, which are never seriously interfered with by drifting snow or by sleet and ice, throws but little light on this problem. At that time only one automatic stop, that of the Rowell-Potter Safety Stop Company, had been completely tested under actual traffic conditions, although several had been approved by this board for purposes of such tests. It is very much to be regretted that up to the present time only one additional automatic stop, that of S. H. Harrington, elsewhere described, has been made ready for a test by this board under service conditions.

As both of the stops which have been tested are of the mechanical trip type, there is no information available as to the practical performance of three other types of train-control systems. These other types include contact rail systems, systems requiring the use of short insulated sections of track and the insulation of certain parts of the engine, and systems making use of inductive or magnetic forces.*

Concerning the Rowell-Potter stop the board said:

> As regards the system as a whole, the board concludes that if the faults mentioned (in the report) were remedied, and it sees no reason why they should not be substantially overcome, and if the apparatus were well inspected and maintained, the system would be safe and reliable, and its use would tend materially to promote safety of operation on a railroad using it. As to its economy, there is insufficient data to form a conclusion of any real value.

Concerning the S. H. Harrington stop the board said:

> The system, with reasonable inspection and maintenance, would be safe and reliable and its use would tend materially to promote safety of operation on a railroad using it.

While the results of the tests on these two mechanical trip devices indicate that their use would materially promote safety in railroad operation, the board considers it manifestly improper to make any recommendations concerning the compulsory adoption of automatic-train stops based on them alone. Such recommendations should be based on the results obtained from tests of all types of devices believed to offer promise of meeting the varied requirements of railroad operation. Some types will meet those requirements in one degree and some in another.

This board, in its second annual report, in dealing with the same matter, said that it was not prepared at that time to make a definite and positive recommendation for the use of an automatic stop; and said further:

> It is reasonable to expect, however, that when the systems which have been approved by the board for test have been subjected to severe trial under service conditons and have had any faults which such tests may develop corrected, it will be found that several forms of automatic train controlling devices are available for use.

As a result of the recent introduction of automatic stops on some electric roads, and for other reasons, there has been some little development during the past year. One electric surface railroad in the state of Washington, the interurban line of the Washington Water Power Company, between Spokane, Cheney and Medical Lake, has put me-

*While an installation of the latter type, as embraced in the Perry-Prentice Hertzian wave system, has been examined, the conditions under which it was operated were not those to be found in general railroad practice. The results, however, indicated sufficient promise to warrant the encouragement of further experiments and an installation of the system on some railroad where its actual merits could be more completely demonstrated.

chanical stops in use on 27 miles of its line. Signal engineers have been studying the subject more generally. With the extension of electric propulsion of trains, the problem of the use of train stops becomes simplified.

On steam railroads the only sources of mechanical power usually available are the boilers of the locomotives themselves and the steam plants in the shops of the larger yards. Hence, the installation of signaling systems requiring power for their operation has necessitated the installation of engines and pumps for supplying compressed air, or the installation of primary batteries or electrical generators for supplying electrical current for the operation and control of signals. Power generated chemically in primary batteries is expensive, and the losses incident to the transmission of the energy for operating signals over line wires of considerable length are serious.

The substitution of electric propulsion for steam propulsion on railroads provides a readily available source of power for signaling or train controlling apparatus which is continuous throughout the length of the road. The electrical energy for propulsion purposes being generated in large quantities is relatively cheap per unit, and for this reason it is believed that the electrification of steam railroads will tend materially to effect an increase in the extent and efficiency of signal installations. To even a greater extent is electrification likely to encourage the use of the automatic train stop by providing available power for the operation of these devices which, it is believed, will in many cases be found to require for their operation more power than the usual forms of fixed visual signals.

Negotiations between the Pennsylvania Company and the Gray-Thurber Automatic Train Control and Signal Company have resulted in an installation of the Gray-Thurber system being undertaken on the westward main passenger track on the Pennsylvania lines, between Jacks Run and R N tower, Glenfield, Pa. It is intended to equip two engines, one running regularly in suburban service, the other running regularly in through-passenger service. As hereinbefore mentioned, the New York Central has offered facilities for a test of the train-control system of Mr. A. H. Fox, between High Bridge and Yonkers, N. Y., on the Putnam Division of that road, and the Washington Water Power Company has installed mechanical automatic stops, as already noted. These installations, encouraged by the railroads themselves, are significant, and are in line with suggestions contained in our last report, in which it was pointed out that—

> The art of automatic train control, like the art of signaling, must be developed by those most intimately concerned in its use; namely, the railroads themselves. It is not to be expected that trials or tests conducted by the government will, independently of extended use by railroads, result in the production of devices or systems fully developed to meet all the exacting conditions of railroad operation. The real value of any mechanism can only be demonstrated by its extended use in the place and for the purpose intended.

The most serious obstacle to the practical development of systems approved for experimental test has been the fact that proprietors have lacked the financial means needed to carry on their work. Large sums of money have been spent in private enterprises to develop devices which have been found to possess little merit. It is a matter of common observation, now as for years past, that devices having no merit succeed in attracting capital by methods scarcely less than fraudulent. Instances of this kind have been observed in connection with devices which have been considered by this board and rejected as worthless. On the other hand, some devices which appear to possess decided merit have remained undeveloped for lack of money or business ability on the part of their inventors. Inventive faculty and business ability seldom go hand in hand. Under existing law the Commission has no authority to expend money except in connection with the investigation of such systems and appliances as shall be furnished for investigation free of cost to the Government. The board has seriously considered whether the objects of the investigation contemplated in public resolution No. 46 and its appropriation act might not be more speedily and effectively accomplished by a provision authorizing the expenditure of money for the development and installation of meritorious devices under regulations similar to those adopted by the German Government.* In view, however, of the very great expense that would be involved, and of the fact that the Government has no permanent railroad (except in Panama), such a scheme would be difficult of accomplishment.

A difficulty of a different sort confronts the railroads. One objection which has been urged against the introduction of new safety appliances is that after a partial introduction of them a liability for damages might exist in connection with accidents on parts of a railroad not yet equipped with them. It has been suggested that such a situation might be met and the objection entirely overcome, so that no injustice would be done to the railroads, by a simple enactment that the partial application of such devices should not of itself create any legal obligation to equip the entire line in the same manner; that such fact should not be admitted as evidence in any court of an obligation to equip any part of a road not already equipped; and that any case of damage occurring on any portion of a road not equipped should be determined without consideration of the installation on another part of the road.

The board considers it no part of its duty to suggest the form of legislation, but it is quite possible that some legislation of the character indicated, as a matter of justice to the railroads and to remove from the minds of railroad managers any prejudice against the tentative application of devices intended further to safeguard the public and the railroad trainmen, would be proper. The enactment of such a law would tend to promote the development of the appliances under consideration.

While the board confidently expects the automatic stop to be developed to a point where, like the block signal, the car coupler, and the train brake, it will be available to railroads generally, and in many situations will constitute one of the factors promoting safety in train operation, the board is led to believe from its study of existing conditions, particularly as found in connection with the means now employed for the safe movement of trains, that the primary cause of the lamentable record of collisions in this country is of so serious a nature as not to be susceptible to complete cure by any mechanical means. It is not to be considered that the automatic stop, or that any automatic device, will be a panacea for all the faults at present existing in train operation. The question really is whether by the introduction of automatic devices the percentage of accidents due to those faults can be reduced.

It is an unwelcome thought that the fundamental responsibility for the relatively large number of collisions in this country is chargeable to railroad officers and employes; not to them because they are more careless or less sensible of their responsibilities than men in other vocations, for that can not be truthfully said, but simply because they possess the qualities, mental or temperamental, which are the cause of these deplorable results, and which are symptomatic of

*Experiments have been carried on during the past six years in a number of different districts of the railway system owned or controlled by the German government looking to the selection of the most practicable and suitable device for preventing the overrunning of stop signals by enginemen. The results, while interesting, have as yet shown nothing that is conclusive, beyond what has been learned by experiments made in this country and in England. Automatic stops have not been favored at all, the German Railroad Union, a quasi-official body, having voted that the desideratum was an indication in the cab to warn the engineman. One "wireless" apparatus was tried. So far as this board is informed, the only change in practice that has been introduced as a result of the investigations is the limited or tentative adoption by five different directorates of a "recording alarm," an apparatus for recording automatically on a locomotive each instance in which a stop signal is disregarded by the runner of that locomotive and compelling him to report himself.

characteristics common to all who have been reared in a new and rapidly developing country. But sober reflection leads inevitably to the conclusion that, outside of the army and navy, the American is not reared with that discipline which becomes a part of the man and governs his actions mechanically, as it were, rather than as the result of reasoning. Such discipline leads to action as one's first duty without question or reason, and the sense of duty is the one predominating quality which influences the man's every action unconsciously and unfailingly. This conclusion is brought home all the more convincingly when one reflects that nowhere in the world have appliances for safeguarding railroad transportation been so highly developed as in this country, notwithstanding which nowhere in the world is there a greater proportionate number of accidents of the kind which such advance in the art should prevent. The automatic stop, therefore, while it might be unnecessary under different social conditions, may be expected to add to safety in train operation under the conditions which do exist and must continue to exist in this country until we shall some to appreciate and realize all that may be accomplished by discipline of the right sort. But mere discipline will not suffice alone. There must go with it the spirit which prompts obedience for the pleasure of being approved by one's own conscience.

It being admitted that what is most needed is automatic performance of one's duties rather than automatic mechanical devices, how may it soonest be brought about? The causes that militate against the development of the human machine to perfection of disciplined action are so complex and so interwoven with our social being that many of them can be eradicated only by that slow evolution or growth which results from the operation of natural laws and which can hardly be forced or even guided by the enactment of man-made statutes.

Nevertheless a number of these causes appear susceptible of marked and present improvement. Appeals to conscience may develop a high sense of duty in many men, but the ever-present problem of earning a living, by its very insistence, makes the appeal to self-interest powerful and practical. The pension system as in force on a number of prominent roads and as advocated by the board in its report last year is believed to offer a strong inducement to careful conduct and should be encouraged.

The existence in the regulations of some railroad companies of rules that are unfair or non-enforceable, and intended only as an extreme legal precaution to protect the companies, is nearly as bad in its effect upon discipline as the failure of railroad officers rigidly to enforce those rules which are proper and necessary to safeguard traffic.

The American Railway Association some years ago prepared, and with painstaking effort has since amended and improved, its standard code of rules governing train operation. It is unable to compel their use or their uniform interpretation and enforcement on individual roads. The causes heretofore mentioned and others affecting discipline have the bad effect of impelling railroad employes to move about from one road to another. This tends to decrease safety in operation by frequently placing men in unfamiliar surroundings; and the condition is made still more undesirable by the lack of uniformity in rules and procedure on different roads. A case where, on a single-track railroad 150 miles long, used jointly by the trains of three different companies, a system of whistle signals is used on the trains of one company which is entirely different from that used by the other two, is an aggravated example. Legislation in at least one state requires railroad companies to file copies of their operating rules with the state railroad commission, and makes any infraction of the rules by an officer, agent, or employe a misdemeanor. From this to a federal requirement of the same nature, and, what is more important, enforcing uniformity, is but a short step and one likely to be advocated in the absence of an improvement in railroad procedure in this respect.

The law passed by Congress at its last session (Public, 165) authorizing the Commission to investigate train accidents, should tend to make for better methods and improvement in personnel by directing public attention to those defects and deficiencies which have resulted in train accidents, and thus lead to their correction. But on the theory that prevention is better than cure, it is obviously the part of wisdom to take all practicable measures beforehand to prevent those evils that have heretofore resulted in collisions rather than to wait for the occurrence of accidents to disclose the existence of the evils. Investigations such as the board has been conducting into block-signal and other operating methods, therefore, should be continued and conducted on a larger and more comprehensive scale than has been done in the past. This is necessary, with or without a law requiring the use of the block system.

Again the board desires to express its obligations to the American Railway Association for its co-operation in securing the consent of railroads for the installation of apparatus on their tracks for purposes of test, and to the officers of railroads who have extended courtesies which have made it possible to conduct practical investigations in the field.

Consul Alfred A. Winslow, Valparaiso, reports that the Chilean government has outlined extensive public improvements for 1911, covering railroad buildng, harbor improvements, waterworks, sewer systems, etc. The estimates for new work on the thirty-five railroads under construction by the government amount to $10,194,450 United States gold for the year, with $1,080,578 for surveys for new lines, condemning right of way, etc., and $365,000 for new rolling stock to be used on the new lines under construction, to say nothing of the new equipment needed for the old lines. The above estimates do not cover the work to be done on the Longitudinal and Arica to La Paz railways that are under special contracts. The former is to be built and operated for a time by English syndicates with headquarters at Santiago before being taken over by the Chilean government on a guaranty of 5 per cent net on the actual cost of the road and rolling stock. This line is divided into two sections. The northern portion, consisting of 443.6 miles, extending from near Iquique to a point near Chanaral, is being financed by the Chilean Longitudinal Railway Construction Co. (Ltd.) and the Chilean Railway Finance Co. (Ltd.), with offices at Santiago, in charge of W. B. Leane. The construction of this section has been taken over by Macdonald, Gibbs & Macdougall at a cost of $10,900,963, to be completed within three years. This firm can be reached at Santiago, Chile, in care of the Chilean Longitudinal Railway Construction Co. (Ltd.) The construction of the southern section, consisting of 310 miles, is being financed by the Howard Syndicate (Ltd.), with offices at 1263 Calle Compania, Santiago, Chile. The construction work is being done by Griffiths & Co., for $19,592,529, to be completed within three years. This firm can be reached at Santiago, Chile, in care of the Howard Syndicate (Ltd.) The work on these sections will require 3,500 to 4,000 workmen, of whom 2,000 must be brought from Europe. The consul suggests that here is a fine opening for railroad construction material of all kinds, and he thinks it will pay American interests to get in touch, as work will begin soon.

The Pay-As-You-Enter Car Corporation, New York, and the Pay-Within Car Company, Philadelphia, Pa., have been merged into one organization. The new company will be the Prepayment Car Sales Company, with office at 50 Church street, New York.

The Maintenance of Way Department

RAIL BRACES AND SLIDE PLATES.

Editor Railway Engineering.—I do not favor rail braces throughout crossovers, but prefer tie plates instead. We do not use slide plates all the way across switches except one plate which is termed the head plate fitting just ahead of the No. 1 or first plate under switch points. This plate is sometimes called the gauge plate. The remainder of the slide plates used in connection with our switches are placed under the switch points and main line rail with the necessary offsets required for elevation or raising of the points the necessary height above the main line rails.

Roadmaster.

Editor Railway Engineering.—Rail Braces, I think should be used only on crossovers opposite the switch points, placed on every alternate tie, 10 rail braces at each switch. This will meet the requirements where proper switch timbers are used. I use slide plates all the way across the switches. Do not use short plates under each rail in any case.

Roadmaster.

Editor Railway Engineering.—We use braces through the entire cross-over, except where tie plates are used, in which case we do not use any braces. I think it preferable to use braces over the entire cross-over, as there is fully the strain on the rails between the two tracks that there is between the switch points and the frog, account of reverse. We do not use slide plates all the way across switches, except at the point. The balance of the switch is held up by short plates under each rail.

Roadmaster.

Editor Railway Engineering.—I do not favor rail braces throughout crossovers, and use them only where tie plates cannot be used. We do not use slide plates clear across switches, except in the case of the headblock, where we do use one gage plate. With this one exception we use short slide plates under the switch points.

Roadmaster.

Editor Railway Engineering.—We do not use rail braces, but use Goldie Claw tie plates under each rail throughout the switch, and also on curved track behind the frog. We use tie plates on all curves over 10° on main line. Switch ties are expensive, and should be tie plated; tie plating prevents spreading of track, and is a saving in the long run. Rail braces are out of date.

Roadmaster.

Editor Railway Engineering.—Referring to rail braces and tie plates on switches and cross-overs. I do not prefer using rail braces on cross-overs and turnouts, but tie plate them in full using short plates under each rail only.

Roadmaster.

Editor Railway Engineering.—Regarding rail braces I wish to say that I prefer rail braces throughout cross-overs. As to slide plates I wish to advise that we use slide plates all the way across switches

General Roadmaster.

Editor Railway Engineering.—I do not prefer rail braces. I prefer tie plates instead. While we do use the short tie plates under rail in crossovers and switch leads I would prefer tie plates all the way across the switches and frogs.

Roadmaster.

Editor Railway Engineering.—With reference to rail braces, I beg to advise that I favor rail braces or tie plates throughout cross-overs. As to slide plates, I use short ones, under each rail.

Roadmaster.

DIAL AND TRANSIT CLIPS.

Editor "Railway Engineering":—

In my opinion the dial clip is superior to the transit clip for attaching switch rods to points. The dial clip is a safe device, cannot be tampered with without removing the bolt. With the dial clip better adjustment can be made, better line and better gauge can be maintained through the switch, which is essential, more particularly for high speed track. It is more difficult to maintain perfect gauge and line with the transit clip. It is important that switches be maintained in perfect condition; they must be in perfect line and in perfect gauge in order to give the desired results, that is, no worse effects should be felt on a train passing over a switch than would be in any other part of the track.

Roadmaster.

Ontario.

Editor "Railway Engineering":—

I never had any experience with any other than the dial clip for attaching switch rods to points and which are giving good satisfaction. A large system out here uses the transit clip and really it seems somewhat superior to the dial clip, inasmuch as the adjustments are made by use of the pin fastened with a key, which can be done more readily than with the dial clip which is made secure with a bolt and nut which are a little more difficult to remove and replace than the pin and key above referred to. As heretofore stated, the dial clip is giving good service, and, in fact, I have never heard any complaint in regard to it except for reasons above given—that of foremen not being so apt to keep points properly adjusted, as it is a little more difficult to remove the bolt and nut of the dial clip than it is to adjust with the pin and kep above described, which are used with the transit clip.

Roadman.

Montana.

Editor "Railway Engineering":—

Referring to the question of the transit and dial clips to be used on head rods, connecting switch points. I am of the opinion that the transit is the much better clip of the two. One reason is that the adjustment is more simple and has less friction parts as compared to dial clips. The two little studs in dial clips that govern the position of the dial becomes worn and if not watched closely and properly cared for will get out of place and in handling such as shipping, the parts often become disconnected and lost, and do not arrive complete at point where to be used. It is also my opinion that a clip should be attached to the head rod and be a fixed part of same in handling, instead of clip being attached to point at factories or stores, thus eliminating the trouble incident to being incomplete when arriving at destination.

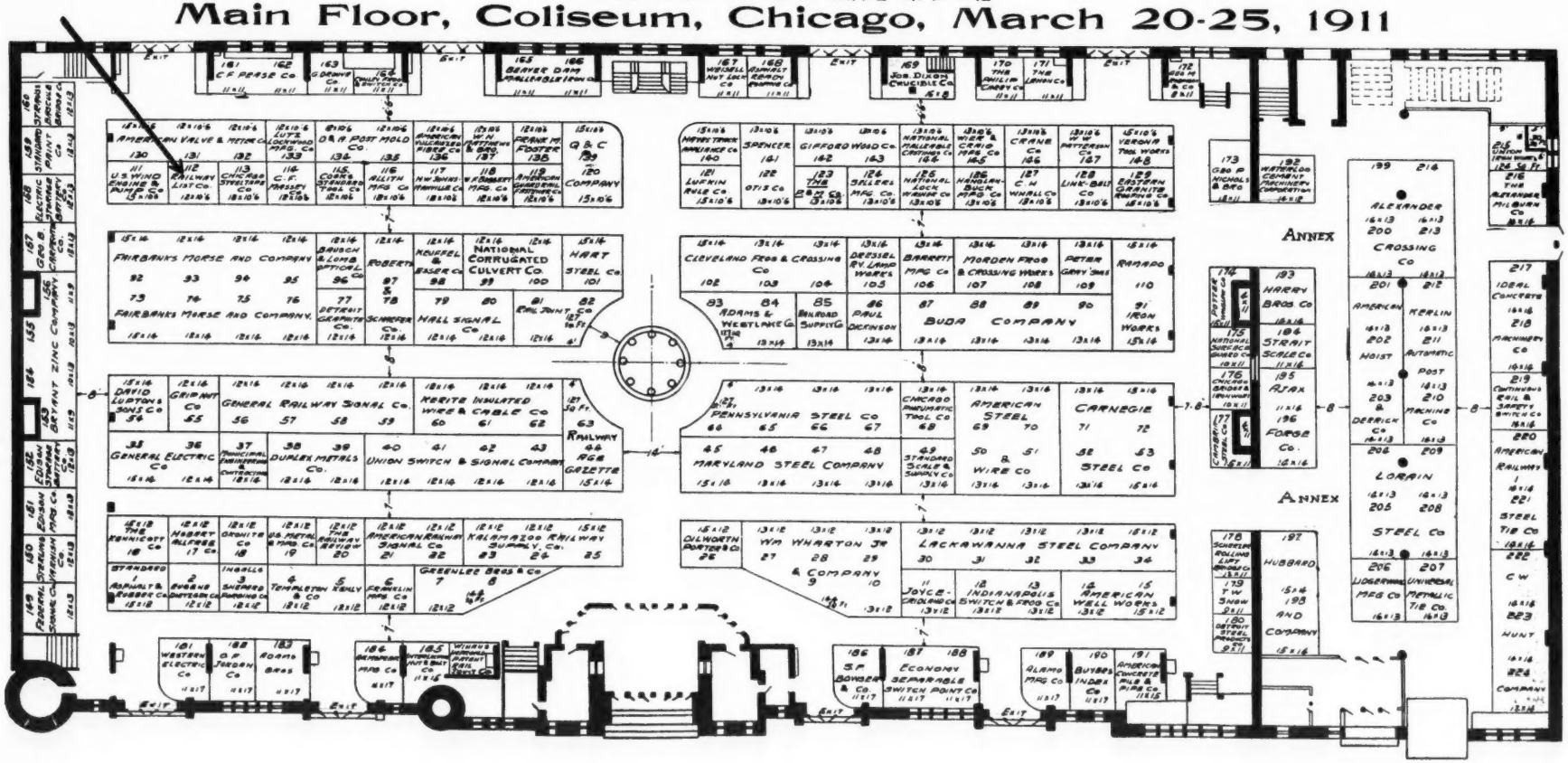
CONSTRUCTION COSTS IN SIBERIA.

Lester Maynard, United States Consul at Vladivostok, furnishes the Department of Commerce and Labor some valuable statistics concerning the Siberian Railway, which are of interest to all students of railroading. Mr. Maynard says:

It is reported that the Russian government contemplates the improvement of the existing Siberian Railway and creating duplicate approaches both in European Russia and the Far East. When these works are completed, in 1915, the Imperial treasury will have expended on the Siberian Rail-

Plan of the Exhibits at the Convention Exhibition.

Main Floor, Coliseum, Chicago, March 20-25, 1911



way somewhat over $1,000,000,000, which includes both cost of construction and loss on exploitation. In exchange for this Russia will have a complete double track system from the Urals to the Pacific, with double approaches, of a total length of 6,844 miles.

During 1910 the Ministry of Communications introduced into the Douma three bills providing for parts of this vast work. The first is to double the Baikal-Kultchuk section of the Circumbaikal Railway, the second is concerned with the eastern part of the new Amur Railway, and the third is for double-tracking the existing Transbaikal Railway. The most important work strategically is the Amur Railway, which will supply Russia with communication with the Far East, running through Russian territory alone, as against the existing Chinese Eastern line. The new Amur line will be 1,244 miles long, and, as officially estimated, will cost $121,050,000, but including rolling stock, guarding during construction, and the usual percentage of estimated expenditure, the cost is put at $149,244,000. With the completion of this work, which has been two years in hand, Russia will for the first time have railway communication with the Far East lying entirely in native territory.

The second great work under way is connecting St. Petersburg and the European Northern Railway system with the main Siberian line, the chief approach to which has hitherto been through Moscow and Central Russia. This new line runs through the towns of Perm, Elkaterinburg and Tyumen, and joins the Siberian Railway at Omsk. The section from Perm to Ekaterinburg is finished. The total cost of this new approach and incidental improvements will be $43,243,000.

Doubling and improving the existing track of the Siberian Railway is the next work. This was begun in 1907. For three section of doubling work, and for reconstructing the hilly parts of the Eastern Siberian Railway (between Atchinsk and Irkutsk), the Ministry of Communications has asked for $82,309,000, but in addition there are sections for which no estimates have yet been prepared, also the needed improvements of the Ussuri Railway (from Vladivostok to Habarofsk), and rebuilding of stations. Adding these costs, calculated on the basis of past outlays, the Russian engineer, Mikhailovsky, puts the cost of reconstructing the existing Siberian line at $97,966,000. This makes a total cost of new works undertaken during the past three years of $290,453,000.

Engineering defects in the line will remain in steep gradients in the Transbaikal Railway, which requires double power, a large number of short curves, and wooden bridges over the narrow rivers, which are constantly destroyed by fire. The correction of these defects will bring the total to $302,210,000.

The statiscal department of the Ministry of Communications put the construction outlay up to 1907 on the Siberian and Manchurian Railways at $422,412,000. The losses on exploitation during the 14 years which have elapsed since 1896, when the western section of the Siberian line was opened, are given at $211,693,000. The exploitation losses for the six years which will elapse before the present schemes are finished will amount to about $60,831,000. This makes the total cost of the completed Siberian Railway $997,146,000, or about $146,827 per mile, notwithstanding that practically no compensation had to be paid for land and that more than half the line runs through flat territory.

ANCIENT BUILDING CONSTRUCTION IN INDIA.

During the earthquake of 897, some of the crumbling walls of ancient houses disclosed earthenware cylinders, 8 ins. long and 5 ins. in diameter, which were embedded within the walls, and were at the time suspected of having been used merely to save more expensive material. But the recent invention of porous tubes placed within walls, which it is desired to divest of their humidity, and which are successfully dessicated in this way, raise the question whether the Indian mason of a century or so ago did not grope his way to a homely "intelligent anticipation" of one of the rather useful and highly scientific inventions of the twentieth century.—Indian Engineering.

RAILWAY CONSTRUCTION.

The Buckhannon & Northern R. R. has awarded the contract for grading and masonry work from Rivesville, W. Va., to the Pennsylvania state line, a distance of 32 miles, to Patterson, Moran & Luck, of Pittsburg, Pa., for $700,000. S. D. Brady, Fairmont, W. Va., is chief engineer.

The Montgomery & Chattanooga Railroad Co. has been incorporated to build a line from Montgomery to Anniston via Central, Alexander City and other points. It will develop some valuable timber lands between the Tallapoosa river and Alexander City. The section of 52 miles between Montgomery and the last-named point will be built first. Benjamin Russell of Alexander City, is president; J. C. Haas, of Montgomery, vice-president, and W. T. Roberts, of Montgomery, secretary and treasurer. Capital, $50,000.

The Canadian Pacific is ready to receive bids for the construction of the second section of 30 miles of the Kootenay Central. The line is projected a distance of 175 miles and when completed will connect Golden, B. C., on the main line, with a point near Galloway, on the Crow's Nest extension. The first section of 10 miles was completed some time ago. The line is to be built in sections of about 40 miles, as circumstances in the British Columbia new settlement district seem to warrant.

The Fort Smith & Western, according to press reports, will take out a charter in Oklahoma in the near future for the purpose of building an extension from the present western terminus of the St. Louis, El Reno & Western, at El Reno, Okla., southwest to a connection with the Kansas City, Mexico & Orient, near the Red river.

An extension of the Garden City, Gulf & Northern is being built under the name of the Scott City Northern, from Garden City, Texas, north to Scott City, thence via Logan county, to Winona, on the Union Pacific, 50 miles. It is expected to have the line finished by July 1, 1911. Track has been laid on 20 miles. The work is heavy and includes handling about 15,000 cu. yds. per mile. Maximum grades will be 0.7 per cent. There will be 10 trestle bridges, to have a combined length of one mile. The line is benig built to carry live stock, sugar beets and farm products. Contracts have been let to A. L. Sedbrook, S. S. Shaw., H. W. Harper, A. J. Canady, S. Brown, all of Scott City, and the Midland Bridge Company, Kansas City, Mo.

It is reported that the Alexandria & Western is to be built in the near future from Alexandria, La., westerly towards Leesville and eventually into Texas. W. H. Larson, secretary and treasurer; I. W. Sylvester, chief engineer, Fort Worth, Texas.

Announcement is made that work on the connecting line of the Canadian Northern from Ottawa, Ont., west to Port Arthur, is to be started this coming spring. In addition, plans have been made to build about 1,500 miles of branch lines in the prairie provinces.

The Atchison, Topeka & Santa Fe, according to press reports, will build an extension under the name of the Pecos Valley & Northeastern from Pecos, Texas, south about 150 miles to Boquillas.

Concerning the Grants Pass & Rogue River it is reported that contracts are being let and work is to be started early in March on a line from Grants Pass, Ore., to the head of Williams valley, 30 miles. The line is being built to carry lumber, fruit, ore and agricultural products. A. D. Bowen, president, Spalding building, Portland; J. E. Gardner, chief engineer, Grants Pass.

The Kentucky-Tennessee Traction will let contracts early this spring to build from Hopkinsville, Ky., southeast via Salubria Springs, Pembroke and Trenton to Guthrie, on the Louisville and Nashville, about 25 miles. There will be three steel bridges and one overhead railway crossing. Plans are made to put up a power house and substations. The Arnold Co., Chicago, are the engineers. Charles Vanden Burgh, general manager, Hopkinsville.

The St. Louis, Peoria & Northwestern Ry. Co. has been incorporated to construct a railroad from a point in or near the city of Peoria, in a southerly direction through the counties of Peoria, Tazewell, Mason, Menard, Sangamon and Macoupin, to a connection with the Macoupin County Ry., at a point about two and one-half miles south of Girard, in Macoupin county. Principal office, Chicago. Capital, $25,000. Incorporators and first board of directors: Marvin Hughitt, Chicago; Chauncey Keep, Chicago; Byron L. Smith, Chicago; Barrett Conway, Chicago; John V. Farwell, Lake Forest, Ill.; William A. Gardner, Evanston; John D. Caldwell, Oak Park.

The Eastern Utah has been incorporated in Utah with $500,000 capital, to build about 60 miles of line from Wellington, Carbon county, Utah, southwest to Emery, Emery county, about 60 miles. The incorporators include: H. Wade, president, Price; O. Seely, vice-president, Castle Dale; N. V. Maloney, secretary, and I. R. Parsons, treasurer, both at Price.

The Panaman government has announced that it will receive proposals for the construction of the railroad from Panama to David, near the Costa Rican frontier, and a branch to Los Santos until June 30. The conditions for the contract will be placed in the hands of the Panaman consul generals in the United States and Europe. According to the plans the railroad will be 362 miles in length.

Announcement has been made by the Chicago & Northwestern Railroad that about $700,000 is to be spent in improvements at Boone, Ia. A new yard of three times the present capacity will be installed.

The Madison County Railway Co., Stackhouse, N. C., is building 10 miles of line with its own forces through the mountains from Runion to Allenstand, N. C., connection being made at Runion with the Southern Railway. The Laurel River Logging Co. is back of the enterprise. A. G. Betts is president and treasurer; A. A. McQuide, vice-president, and E. B. McMillan, secretary.

The Blakely Southern Railroad Co., which has applied for a charter in Georgia, intends to build a line from Blakely to Jakin, Ga., 22 miles, route being due south. Bids will not be asked, but local contracts will be let. It is understood that the officers will include W. C. Snodgrass, president, Thomasville, Ga., and J. A. Mitchell, vice-president and general manager.

It is reported that the Winnipeg, Salina & Gulf, which was organized to build from Winnipeg, Man., south to the Gulf of Mexico, 1,500 miles, expects to let contracts in May and financial arrangements will be completed to secure funds for starting the work by that time. The final location surveys are being made from Alva, Okla., west via Buffalo and Gate to Beaver City, about 100 miles. Survey has been finished from Alva to Hooker, but it will be necessary to resurvey this line. The location survey from Cunningham, Kan., almost to Salina, has been made. Arrangements have been made with the Marine Trust & Savings bank, San Francisco, Cal., to guarantee the principal of all stock sold where the money is used for preliminary purposes. There will be five steel bridges and a large amount of trestle work is to be carried out on the line. The company also plans to put up a general office building as well as machine shops. H. Leone Miller, president; G. W. Crowell, vice-president, and C. A. Slayton, chief engineer, Salina, Kan.

The Emporium Lumber Co., recently organized by New York and Pennsylvania capitalists, has acquired by purchase 85,000 acres of woodland in the Cranberry Lake region of the Adirondacks and will erect a saw mill and start construction of a railroad from the Mohawk and Malone division of the New York Central to Cranberry Lake, 15 miles distant. In addition to affording facilities for lumbering operations, the railroad will open up to tourists a heretofore inaccessible territory in the Adirondacks.

The Licking River Railroad Co., Yale, Ky., will build 15 miles of line from Yale to Frenchburg, Ky., along Beaver creek, including one bridge over that stream. Line is to be narrow gauge, but on standard ties for conversion to standard later. The officers of the company are: J. H. Fulmer, Jr., president; W. W. Hubbard, vice-president; James A. Roper, treasurer; John T. Johnson, general manager; H. G. Niles, secretary, and H. R. Stone, auditor.

The Grants Pass & Rogue River has been incorporated in Oregon with $900,000 capital. Financial arrangements have been made to begin construction work on a section from Grants Pass, Ore., along the valleys of Rogue river and Williams creek to the Oregon caves in southern Oregon. A. D. Bowen, president; H. L. Chapin, vice-president, Portland. J. E. Riggs, Grants Pass, is an incorporator.

It is reported of the Sand Springs Interurban that grading contracts have been given to Ketchum Brothers and Albro Martin, for building seven miles between Tulsa, Okla., and Sand Springs. The work involves handling about 7,000 cu. yds. a mile. There will be one 20-ft. steel bridge and two trestles, each 30 ft. long. Charles Page, president; W. H. Hendron, engineer, Tulsa.

The Merchants' & Manufacturers Association of Greensboro, N. C., associated with residents of that place, have applied for a charter to build from Greensboro to Carey. The line is to be extended ultimately to Winston and across the mountains into the coal fields. The line will traverse a fine farming and lumbering section. Connection is to be made at Carey with an extension of the Norfolk Southern, which is to be built from Raleigh, about five miles. A bill is now before the state legislature to authorize the construction of the line. C. H. Ireland, Greensboro, may be addressed.

On October 2 last the railway from Melipilla, Chile, to San Antonio was formally opened, in the presence of the vice-president of the republic.

The definite surveys and estimates for the proposed extensions of the Baturite Railway, Brazil, and of the Victoria-Diamantina Railway have recently been approved. The extension of the Baturite Railway will be a little over 18 miles long, from Iguatu to Cedro, while the Victoria-Diamantina will extend 161 miles over the section between Itabira and Matto Dentro and the line to Santa Anna dos Ferros.

A contract has been let for the connection of the West of Minas Railway in Brazil with the Goyaz Railway. Specifications provide for payment on unit basis. Name of contractor may be had on inquiry from the Bureau of Manufacturers, Washington, D. C. Plans have been approved to extend the Goyaz Railway 159 miles, from Ipamery to Antas, and another extension from Perdicao to Palestina, to cost $2,100,000.

The Chilean government has outlined extensive public improvements for 1911, covering railway building, harbor improvements, waterworks, sewer system, etc. The estimates for new work on the 35 railways under construction by the government amount to $10,194,450 United States gold for the year, with $1,080,578 for surveys for new lines, condemning right of way, etc., and $365,000 for new rolling stock to be used on the new lines under construction, to say nothing of the new equipment needed for the old lines.

Final plans have been accepted for the extension of a branch of the Central of Brazil Railway, connecting G. Portella with Vassouras on the Spaucahy Railway; also a short line to Itacurussa. A central branch to Monte Claros, 37 miles long, will be built at a cost of $800,000, and 21 miles of main line north from Lafayette will be changed to broad gage.

The construction of the railway line from Dean Funes, Argentina, to Laguna Paiva, a distance of 250 miles, was completed last October. This new line is of considerable importance to the development of many agricultural regions, as it extends from the coast of Santa Fe Province to Dean Funes, a town on the northernmost section of the Province of Cordoba.

It is said that during 1911 work will be commenced on 1,800 miles of new railways in Russia.

The Chilean government has granted to Gibbs & Co., of Valparaiso, a concession to construct a private railway from Chucumata to the rich nitrate fields of the interior.

The Minas section of the Bahia-Minas Railway, Brazil, extending from Aymore station to Theophilo Ottoni, a distance of 146 miles, has been purchased by a group of capitalists, who are authorized to use the power of the waterfalls which are found within a distance of five miles of the line, for the future electrification of the road.

Messrs. Amandio Fidencio Lampert and Pedro A. Goncalves de Carvalho have obtained a concession from the Brazilian government for the construction of 63 miles of railway in the valley of the Cahy river, extending from t Port of S. Joao de Montenegro to the boundary of the district of Caxias, in the state of Rio Grande do Sul.

It is proposed to construct a railway connecting the Nigerian tin fields in the province of Bauchi, Nigeria, Africa, with the Baro-Kano line.

The Buenos Aires Great Southern, with 3,038 miles of line, is now the largest Argentine railway, exceeding the Buenos Aires & Pacific with its 3,028 miles.

The Buenos Aires Western Railroad Company, Argentina, has been authorized to construct and operate a branch line, 49 miles long, to connect the La Zanja station with that of Meridiano V.

Messrs. Gibbs & Co. have secured from the Chilean government a concession for the construction and operation, during 50 years, of a railway from Caleta de Chucumata to Oficina Alianza, a distance of nearly 55 miles.

The department of public works of Brazil has signed a contract with Messrs. J. de Oliveira Fernandes and Humberto Saboya de Albuquerque for the construction of the section of the West of Minas Railway, between Henrio e Galvao and kilometro 48 on the Goyaz Railway. By the terms of the contract the line must be completed within 18 months.

The Eastern Utah Railroad has been chartered to build a line 60 miles long connecting Wellington, Carbon county, and Emery, Emery county. The line, it is said, will tap one of the richest sections of Utah. It is understood that the route to be followed is part of that surveyed many years ago by the Rio Grande Western for its Salina cut-off, and which it afterward abandoned.

Personals

G. W. Trout, supervisor of signals, Rock Island Lines, at Rock Island, Ill., has been appointed signal engineer of the Pere Marquette, at Detroit, Mich., vice W. J. McWain, deceased.

W. J. Lank has been appointed division engineer of the Atchison Topeka & Santa Fe Western Lines, with offices at Clovis, N. M.

E. E. Ball has been appointed division engineer of the Atchison, Topeka & Santa Fe Coast Lines, with headquarters at Winslow, Ariz., succeeding D. M. Bunger, resigned.

Wm. O'Brien succeeds S. M. Baker as roadmaster of the Cincinnati Hamilton & Dayton, at Ottawa, Ohio.

Thomas A. Lewis, general foreman of bridges and buildings of the Cincinnati, Hamilton & Dayton at Hamilton, has been made master carpenter, with headquarters at Dayton, Ohio.

W. P. Grinnel has been appointed supervisor of subdivision No. 3, Erie Railroad, vice M. J. McCarthy assigned to other duties. Mr Grinnel's headquarters will be at Sharon, Pa.

Mr. B. L. Allen has been appointed chief engineer of the Garden City Gulf, with offices at Garden City, Kansas.

John H. Guess has been appointed assistant general purchasing agent of the Grand Trunk. Mr. Guess will have offices at Montreal.

Mr. F. W. Gilcreast has been appointed chief engineer of the Lehigh & New England, with offices at Mauch Chunk, Pa.

J. D. Mansfield has been appointed roadmaster of the New Orleans, Mobile & Chicago, vice R. M. Sasser, resigned. Mr. Mansfield's headquarters are at Laurel, Miss.

The positions of the following assistant engineers on the Kansas City Southern have been abolished: J. W. Heylmun and G. S. Russell, at Kansas City, Mo.; W. H. Bush, Pittsburg, Kan., and O. P. Allee, Siloam Springs, Ark. A. Leckie has been appointed division engineer at Pittsburg, Kan., in charge of all engineering work previously handled by the above abolished offices. The positions of assistant engineers H. De W. Smith, at Texarkana, Tex., and R. H. Gaines, Mansfield, La., are abolished. R. H. Gaines has been appointed division engineer at Texarkana, Tex., in charge of all engineering work previously handled by these two offices. He has also been made chief engineer of the Texarkana & Fort Smith. The position of H. De W. Smith, resident engineer of the Texarkana & Fort Smith, at Texarkana, has been abolished. A. F. Rust, resident engineer of the Kansas City Southern, at Kansas City, Mo., has been appointed a consulting engineer, and his former position has been abolished. M. A. Box, roadmaster, has been appointed general roadmaster of the Southern division of the Kansas City Southern and the Texarkana & Fort Smith, with office at Texarkana, Tex., succeeding John Gratton, resigned.

F. H. Watts, engineer of the Logansport division of the Pennsylvania Lines West, at Logansport, Ind., has been appointed engineer of the Indianapolis division, with office at Columbus, Ohio, succeeding S. B. Robertson, promoted. E. B. Taylor, Jr., division engineer of the Cincinnati & Muskingum Valley, at Zanesville, succeeds Mr. Watts, with office at Logansport, Ind., and E. F. McCrea, assistant engineer of the Pittsburgh division of the Pennsylvania Lines West, at Pittsburgh, Pa., succeeds Mr. Taylor.

The following officers of the Kansas City Southern have had their authority extended over the Arkansas Western: C. E. Johnson, chief engineer, at Kansas City, Mo.; J. W. Small, superintendent of machinery, at Pittsburg, Kan.; J. J. Taylor, general foreman of bridges and buildings, at Tex-

arkana, Tex.; and P. Gratton, general roadmaster, at Kansas City, Mo.

T. M. Hutson has been appointed supervisor of track, district No 1, of the Louisiana & Arkansas, with office at Stamps, Ark.

A. Bernard, supervisor of bridges and buildings of the Illinois Central, at Durant, Miss., has had his headquarters changed to Water Valley, Miss.

John Roberts has been appointed signal engineer of the New York, Westchester & Boston, at New York City, in charge of the construction, maintenance, and operation of signals, and the telephone and telegraph lines.

A. McCulloch has been appointed chief engineer of the Kettle River Valley, with office at Merritt, B. C.

J. K. Howard, assistant engineer maintenance of way of the Ann Arbor Railroad, at Owosso, Mich., has been appointed engineer maintenance of way, with office at Owosso, succeeding G. R. Endert, resigned. J. P Ramsey succeeds Mr. Howard, with office at Owosso.

J. E. Taussig, superintendent of terminals of the Wabash, at St. Louis, Mo., has been appointed superintendent of terminals of the Houston & Texas Central, with office at Houston, Texas.

C. E. Carson has been appointed superintendent of the Chicago Great Western, with office at Clarion, Iowa.

H. Hatcher, superintendent of the Southern Railway in Mississippi at Columbus, Miss., has been appointed general superintendent of the Georgia, Southern & Florida, with office at Macon, Ga., succeeding O. M. Grady, resigned.

John Franklin Hinckley, of St. Louis, formerly chief engineer of the St. Louis & San Francisco, died on Feb. 20. Mr. Hinckley held the position of chief engineer until two years ago, at which time he resigned to begin private practice.

W. E. Canssey has been appointed superintendent of the Southern division of the Chicago Great Western, at Des Moines, Iowa.

J. A. Gordon, superintendent of the Southern division of the Chicago Great Western at Des Moines, Iowa, has been appointed superintendent of the Eastern division, with office at Chicago.

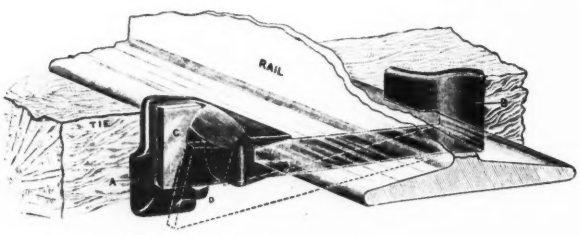
Among The Manufacturers

AN EFFICIENT ANTI-RAIL-CREEPER.

The economy of using efficient anti-rail-creepers has been so thoroughly demonstrated during the past few years, even where creepage is comparatively small, that comment on this subject is superfluous. Among the many devices designed to prevent the creeping of track, the Vaughan type, sold by the M. W. Supply Company, of Philadelphia, Pa., seems to be particularly practical and well adapted to meet the requirements of modern railway engineering.

The Vaughan automatic rail anchor, or anti rail creeper, consists of but two parts, a malleable iron shoe and a high grade spring steel yoke. It is always held tight and operative by the torsional reaction of the yoke which has a direct shackle-hold on the rail base. The design of the device is such that it is physically impossible for it to slip, work loose or rattle, so that there are no maintenance charges. In applying, it is only necessary to grip the square end of the yoke "D" (shown in phantom on cut) with a wrench and spring it into position "CB." Any creeping of the rail will then carry the free or hooked end "B" forward, setting it diagonally across the rail base, and giving it a powerful, grip on the rail. This grip may be given at once by driving the end "B" forward (toward the tie) until slack is taken up.

The device has been on the market a little more than two years and has become practically standard on a number of leading railways, particularly in the east, owing its popularity to the fact that it holds the rail under all conditions, and requires no attention after application.



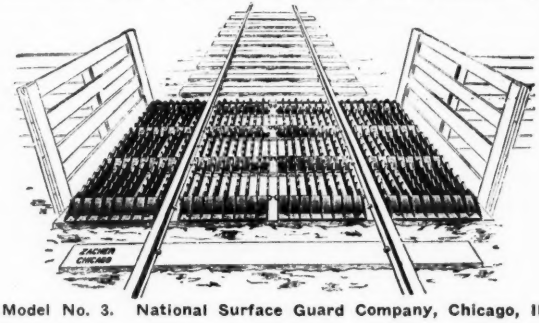
Vaughan Automatic Rail Anchor.

METAL STOCK GUARDS.

The subject of surface stock guards for railway crossings has been an open one for several years, and is still being discussed by railway engineers. Many designs both in wood and metal have been tested thoroughly, the majority of which have given unsatisfactory results. Through these years of experimental work it has been demonstrated that a perfect stock guard must embody the principles of moderate first cost, low maintenance, strength, and durability. It must be of strong construction, and at the same time have enough vibration after being installed to frighten animals that attempt to cross, also to be severe in construction to the extent of causing pain should the vibrating qualities be insufficient, but not severe enough to permanently injure either employes or stock.

It has also been found impossible to construct a surface guard covering these requirements from wood, consequently the railroads are again turning toward steel. The initial cost of steel guards has been an important item in the past, but the price of lumber suitable for stock guard construction has advanced to such an extent, that at present there is very little difference. The slightly higher cost of a metal guard is entirely overcome by the low cost of maintenance, for a metal guard of the proper construction requires practically no attention after being installed, but gives effective service during its life or until accidentally destroyed.

Some have raised the question as to the life of a steel guard on account of the corrosion caused by its exposure to the salt water drippings from refrigerator cars. Such objection has been recognized by metal guard makers up to

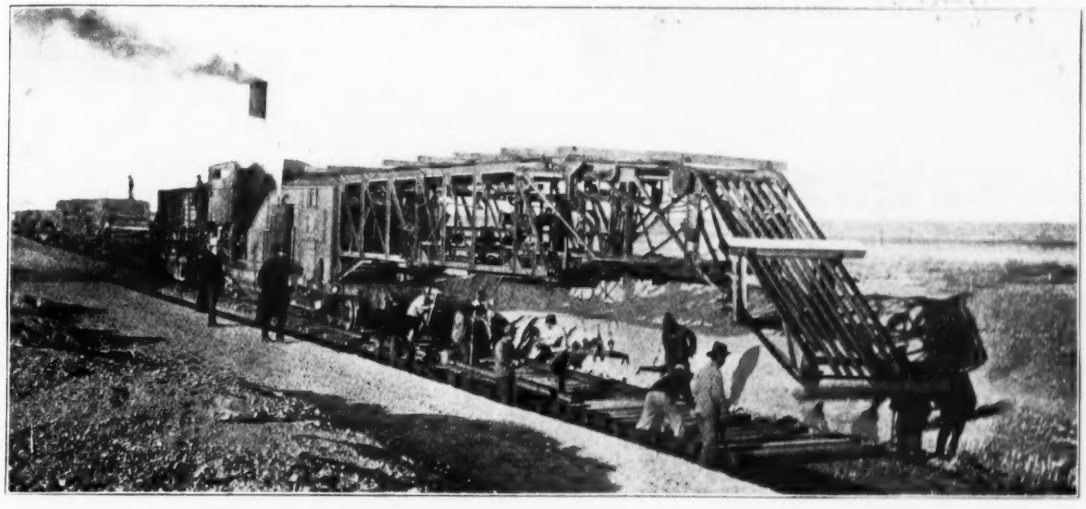


Model No. 3. National Surface Guard Company, Chicago, Ill.

the present, but is being eliminated by the almost universal practice of equipping refrigerator cars with drip tanks. The illustration shows one guard of seven designs manufactured by the National Surface Guard Co. with general offices in the Rookery Chicago, Ill.

TRACK-LAYING ON THE CROSBYTON-SOUTH PLAINS RY.

The illustration shows the Hurley track laying machine No. 4 laying track on the Crosbyton-South Plains Ry. This is a new 40 mile line being built between Lubbock and Crosbyton, Texas, , with a maximum grade of .6 of one per cent and a maximum curvature of 4 degrees. Pine ties and 75-pound rail are being used.



Track Laying by Machine on Crosbyton-South Plains Ry.

The general contract for grading, bridging and tracklaying was let to Walter H. Denison, of Lubbock, Texas. He is obtaining some very good results with this machine, as from 1½ to 2 miles per day of track is being laid and quarter-spiked, using a force of about 50 Mexicans, which includes six gangs of spikers, who are spiking in front of the machine. The labor is of ordinary quality.

From the illustration it will be seen that the method of handling the rails and ties differs very widely from the old methods. In the first place, the rails are drawn forward over the cars by means of powerful compression rollers, located in the machine, the ties being rolled as required onto the moving rails, which act as tie-conveyors to the machine. This does away with the trams, so often used. The ties are then picked up by an endless chain and conveyed over the top of the truss and automatically distributed one by one in position on the roadbed. This is possible because the machine is constantly moving, although very slowly, thus allowing the ties to be dropped in position as the machine moves forward. This method of handling the ties eliminates the large force of tie-buckers ordinarily used in laying track.

The rails after reaching the machine are drawn through the lower chord of the truss by means of compression rollers and lowered to position by steam hoists, the connections being made while the machine is moving forward.

It is apparent that a very large amount of labor is eliminated as the machine itself, to a large extent, distributes the material. Another economical feature of considerable importance is, that the machine, being operated and propelled by its own power, hauls the material train, which saves the cost of keeping a locomotive and crew at the front.

The machines are built and leased by the Hurley Track Laying Machine Co., 277 Dearborn street, Chicago, Ill.

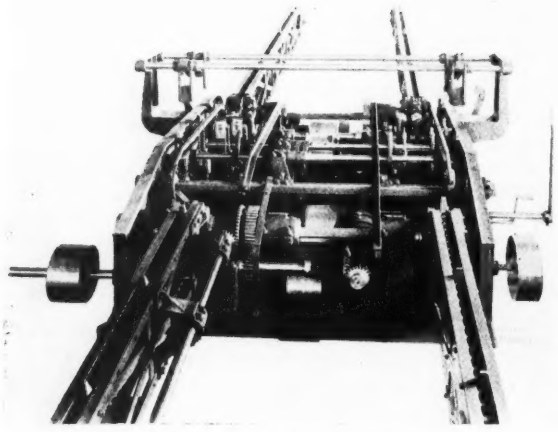
AN AUTOMATIC TIE ADZING AND BORING MACHINE.

A machine for automatically adzing and boring ties is shown herewith. It consists of a heavy cast iron frame about 8 feet square within which are mounted the adzing head arbor, boring spindles, etc., and the shafts, cams, pulleys, and gears for driving the same and for actuating the feeding dogs, and also for driving the conveyors when these are supplied with the machine. The whole mechanism is contained within the frame and it is only necessary to connect it directly or by belts to a source of power.

The adzing device consists of a long arbor 2 7/16 ins. in diameter, carried in long self-oiling bearings. Upon this are mounted the adzing heads which are 16 ins. in diameter and can be expanded to cut any width up to 12 ins. The spacing of the cutting heads is adjustable for variations in track gage. As it is necessary to hold the ties firmly against rocking while passing over the adzing heads, a weight is provided over each cutting head. These weights are free to rise and fall with variations in the thickness of ties, but their bearing faces are always maintained parallel to the guides upon which the ties rest. They have a range of movement sufficient to accommodate ties from 5 ins. to 10 ins. in thickness. To provide against cutting too deep, the ways or guides upon which the ties travel have a vertical adjustment by means of screws and inclined planes, and the depth of cut is regulated by a single hand wheel.

The boring spindles are usually eight in number, arranged in groups of four under the rail points. They are adjustable for variations in track gage and the spindles of each group are adjustable in relation to each other to fit different widths of rail bases and different tie plate standards of hole spacing. The boring spindle feed is timed so that the tie is centered and clamped in proper position before the bit spindles begin their upward travel; the tie is not released until the holes are bored and the bits have finished their return stroke.

The ties are carried over the adzing heads, boring bits, etc., by a series of reciprocating feeding dogs on each side of the machine. These two sets of dogs are actuated by a positive cam and lever movement. A double drive is provided, as it is necessary for the forward dogs to travel at a different rate of speed from that of the after ones. The operating lever controls a large internal band friction, for instantly starting and stopping the feed. This friction is set to slip and prevent breakage in case a tie gets jammed in the machine.



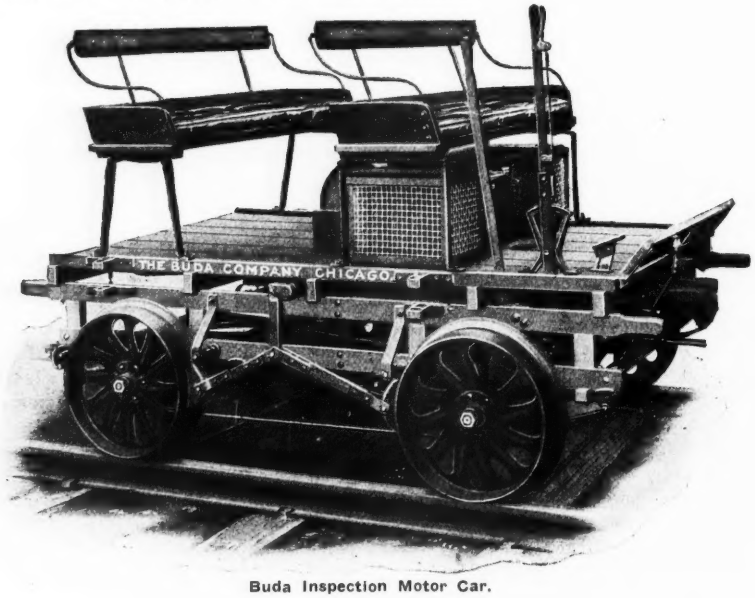
Greenlee Bros. Tie Adzing and Boring Machine.

When it is desired to move ties to or from a distance, the machine is fitted with a system of power driven conveyors, which may be applied to the receiving side or the delivery side, or both. These conveyors are driven from the main drive shaft of the machine through heavy cut gearing. They are made in a number of different forms to suit conditions and can be made up to twenty feet or more in length, with hand or power hoists to elevate the outer ends of the conveyors if desired. A clutch is provided, controlled by the operator's lever, for stopping and starting.

The trim sawing attachment is an attachment not regularly a part of the machine, but which may be added if it is desired to trim the ties to a uniform length. It consists of two cast iron frames at the front of the machine, having arbors upon which the cut-off saws are mounted and which are driven by separate belts. A branding device is furnished optionally to do away with marking-nails, and brass tags. This device consists of two pneumatic cylinders with plungers having dies mounted thereon which are pressed into the ends of each tie as it passes through the machine.

All of the operations performed by this machine are entirely automatic. When the ties are delivered to the machine either by conveyor or otherwise, they are taken by the reciprocating feeding dogs, passed to a point near the trim saws (when the machine is so equipped) where the second set of dogs receives them and passes them through the saws and under the pressure bars. Here they are taken by another set of dogs and carried over the adzing heads. From this point they are moved to a position over the boring spindles where they are gripped and centered by the automatic clamp. The ties remain stationary during the boring operation upon the completion of which they are released and are picked up by another set of dogs which delivers them to the branding device where they are held during the stamping operation. If the machine is not equipped with the branding device the ties are immediately discharged after the boring operation. Owing to the reciprocating feed these various operations are performed simultaneously, sawing being done on one, adzing on another, boring on another and branding on another, at the same time. No step in the process interferes with another and the work proceeds smoothly and rapidly. The operator has nothing to do except to watch the progress of the ties through the machine and be prepared to stop the feed in case a particularly crooked one should become jammed.

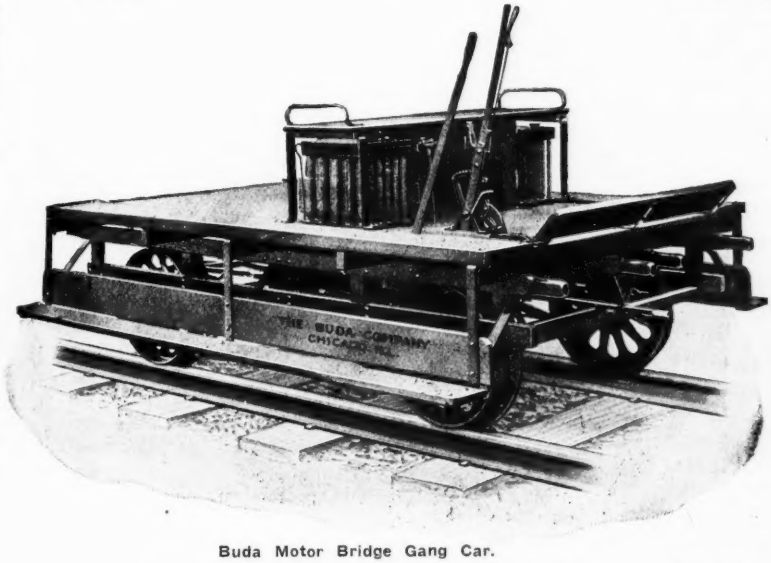
The machine automatically adjusts itself to ties from 5 ins to 10 ins. in thickness and from 7 ins. to 12 ins. wide and will work ties from 8 ft. 3 ins. to 9 ft. in length. When supplied with the trim saw attachment the saws are 30 ins. in diameter, cutting up to 10 ins. thick; the adzing heads cut up to 12 ins. wide; the boring spindles bore holes of any diameter up to 1 in., spaced not less than 4 ins. or more than 6 ins. centers across the tie, and not less than 5½ ins. nor more than 8 ins. centers lengthways of the tie. The productive capacity is limited in practical operation only by the ability to keep it fully and continually supplied with ties. We have found that a speed giving about six completed ties per minute is the most favorable and economical rate to maintain, as the ties cannot be conveniently handled more rapidly than this. The rapidity with which the work is performed and the quantity of shavings, saw dust and waste ends which are produced make it necessary to provide for the removal of this refuse material. As regularly built the machine is fitted with hoods under the adzing heads and bits for connection to a shavings exhaust and dust collector system. When the trim saws are attached to the machine there is also provided a chain conveyor for carrying away the waste ends as they are cut from the ties. The shavings exhaust fan and cyclone dust collector are not furnished with the machine except at an extra charge when specified.



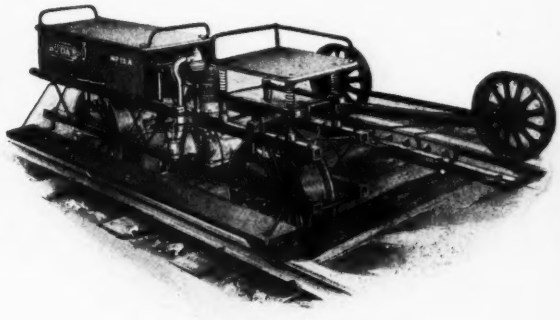
Buda Inspection Motor Car.

Fifty to seventy-five horsepower is required to drive the machine, depending on the working attachments, length of conveyors, etc. Where electric power is available its use is recommended. Where this is not the case it is customary to use a steam or gasoline engine. A very satisfactory high grade six cylinder, vertical, marine type gasoline engine of the required power, which occupies a small space and is economical in its operation is supplied when needed. This machine is equally well adapted to stationary or movable installation. If stationary, a building 40 or 50 ft. wide will amply accommodate. A 40-ft. box car may be utilized in a movable installation. A self-propelling device may be employed for the latter, allowing the machine to move about the tie yard at a speed of two or three miles an hour.

The machine is manufactured and sold by Greenlee Bros., Chicago.



Buda Motor Bridge Gang Car.



Buda Motor Velocipede.

IMPROVED RAILWAY MOTOR CARS.

There are illustrated herewith two new types of motor cars that have recently been brought out by the Buda Company, Railway Exchange Building, Chicago. The two types shown have water cooled engines of 10-12 horsepower, engine model "G," with friction drive transmission. The inspection car will seat comfortably six persons, including the operator. Cushions are regularly furnished, a canopy top with side curtains is supplied when desired, and the car body rests on semi-elliptic leaf springs, suspended from roller bearing pedestals on the axles. These features make it a smooth riding and comfortable car. The car is easily moved off and on the track, eliminating the necessity of running on train orders, and coupled with the fact that the car is always ready, these features should appeai strongly to railroad men, for they can go when they like, as fast as they like, stop when they like, and what is more important, go as slow as they like, giving them an opportunity to inspect track, roadbed, right-of-way, etc., in a careful manner, which would not be possible from the rear of a moving train. This car can also be furnished with an air-cooled engine. Car runs in either a forward or backward direction.

The motor section car for bridge and section gangs is a strong durable car, built for heavy section work. There is ample room on the platform for carrying a large number of men and tools.

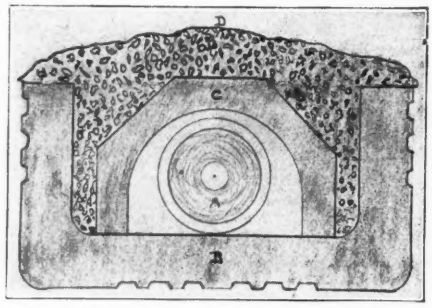
The No. 12-A is one of the latest types of motor velocipedes put out by the Buda Company. It has a 4-h. p. engine, which will readily negotiate any grade ordinarily encountered. It is of the four wheel type, and seats three persons; the front seat rests on coil springs, which eliminate practically all jar. It is very substantially built, both upper and lower sills and guide arms being made of square tubular steel. A foot board runs the entire length of the car.

All of the cars illustrated are equipped with the Buda patented pressed steel wheel, which has a reinforced tread and standard M. C. B. flange. The Buda line may be seen at the Coliseum on March 20 to 25, spaces 87, 88, 89 and 90.

VITRIFIED CLAY CONDUIT FOR SIGNAL WORK.

Permanency of Transmission Line, with the minimum of maintenance cost, is the present desideratum of the largest consumers. In reaching this the initial expense, though of secondary importance, must be practically considered. Starting with the open-wire construction, as having the smallest initial expense soon balanced by the high maintenance cost, and the aerial-cable line, with a higher initial expense and an exceedingly short-lived period of low maintenance cost, progress has brought the various underground systems of construction, with widely diverging maintenance costs, the depreciation depending mainly upon the conduit used and the length of the period over which the maintenance costs are distributed.

To obtain this desired result, i. e., low depreciation, the construction material must be chosen with a view of permanency. The cables may deteriorate or be outgrown, yet the conduit must be of such material as to allow of the pulling out and the repulling of larger cables fifty or more years later. Material tending to deteriorate by any of the degenerating factors of friction, heat, alkali, or acid solution, is not a suitable substance to lie next to the cable in the conduit line. Experience and laboratory tests have both proven that no organic material can be so protected by saturation or otherwise as to withstand these degenerating influences intermittently at work underground. Iron pipe does not outlast some of the better organic fibre compounds. All concrete cements yet used are porous enough to allow saturation of their mass by the acid and alkali solutions constantly present under streets. And though the mass itself may not be materially weakened by this process, the eroding solutions are allowed to seep freely through to attack the cable sheath. The concrete surface lying next to the cable becomes softened, scales off and distributes its debris through the duct, so that in time the duct is of no more use for exchange and repulling of cables than the discarded iron pipe conduit. Neither are all clay conduits possessed of permanent durability. A shale conduit or an



Signal Conduit in Place—A., Cable in place; B., Outer containing conduit; C., Inner cover conduit; D., Cement mortar filler.

On Michigan Central Railroad Right of Way, Windsor, Ont.

easily fusible clay conduit, only protected exteriorly by a glaze, is subject to the same erosive effects as the cement conduit. Only a clay conduit possessing all of the following characteristics of permanency should be selected by the careful consumer.

The Clay Material is of prime consideration in determining the permanent quality of the ware. It must be free from organic matter to have a resultant smooth surface. It must be free from all hard granules of mineral which will make the wall porous and decrease its crushing strength. It must be capable of being powdered to a flour in order that the small granules will amalgamate thoroughly during the burning. It must be so chemically composed that the clay mass will not fuse before vitrification.

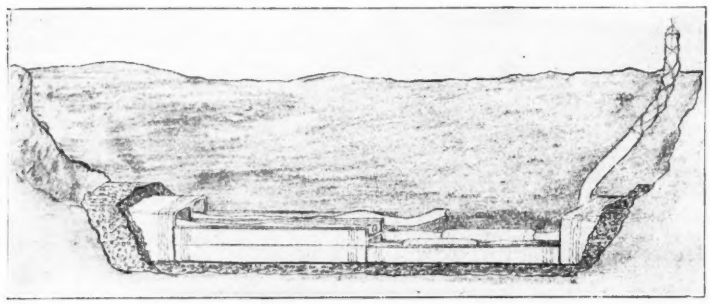
Vitrification is the most essential quality for permanency in conduit. The word signifies the converting of the clay mass into a stone-like substance during the process of burning. The change is both chemical and physical, during which the clay particles lose their individuality and become amalgamated into a homogeneous, impervious mass which will resist all degenerating and eroding elements as effectually as a fine-grained rock. A few simple tests for vitrification are: (1) The piece of ware stood on end and tapped with steel will have the sharp ring of steel with no dull tone. (2) The broken surface of the ware must show no lamineations nor individual clay particles. (3) The broken surface when scratched with a knife blade should erode the steel, making a gray line on the ware.

On account of its position in the conduit field The Clay Product Company has had the advantage of acquaintance with most of the recent plans and discussions relative to transmission for railway signal work. While the application of underground construction to signal work is as yet in its infancy, there has been enough of such construction to prove its worth, though hardly enough to determine upon the best method of laying the conduit.

The factory of The Clay Product Company is located at Brazil, Clay County, Indiana, over what is recognized as one of the best natural bodies of conduit clay in this country. The clay directly underlies the coal layers, which in their formation have extracted all of the organic matters from the clay, leaving a body of very pure hydrated silicate of alumina, mixed with only enough fluxing materials to form a natural fire-clay mixture, just the resultant which is attempted in the artifical mixture of many clay manufacturers. After proper firing, the broken surface of the ware manufactured from this clay resembles a piece of fine-grained porcelain. This clay, properly fired, is a perfect insulator and well-nigh indestructible.

The factory of The Clay Product Company was built and equipped solely for the manufacture of high grade conduit. This company approached conduit manufacture from the point of view of the electrician, not as clay manufacturers seeking to make a new side line. The whole force of the company's organization is centered on the making of the best conduit. No other production is attempted. The workmen are the best artisans obtainable in the country, experienced in the production of this commodity. The whole process of manufacture is placed upon a practical, scientific basis. The clay is scientifically tested, the machinery is the latest and best for the manufacture of a finely screened, floured clay into a perfect conduit. The dry-rooms are regulated on a definite formula calculated to make the straightest and hardest and most homogeneous ware. During the last year the kilns have been fully equipped with recording pyrometers, regardless of expense. The burning is now done in strict accordance with the pyrometric formula which insurs an accuracy of workmanship and a uniformity of product which cannot possibly be obtained by the old cut-and-try methods of cone or test-piece burning.

It has been the intention of The Clay Product Company to so improve the standard forms, and design new economical forms of conduit as to meet every need of the consumer, to save the consumer unnecessary expense in freight labor, repair and general maintenance. How well this aim has been met may be partly appreciated by noting in the accompanying illustrations the economical designs.



Using Split Conduit in Place of Manholes.

A Small Manhole on Right of Way of Chicago Junction Railway, Chicago.

Industrial Notes

The Nickel-Chrome Chilled Car Wheel Co. was incorporated on Feb. 23, at Newark, N. J. The business of the company is to furnish nickel-chrome alloy to makers of chilled car wheels. This alloy it is claimed, increases the tensile strength three-fold, giving strength and hardness to the tread and flange. On a mileage basis it is said the cost of nickel-chrome wheels is but one-fourth of that of steel wheels and one-half the cost of cast-iron wheels. The corporate office of the company is at Newark, N. J. New York office, Hudson Terminal building; Pittsburg office at Frick Annex. The officers of the company are Robert C. Totten, president and treasurer; Stephen D. Barnett, vice-president and general manager; Chas. A. Millington, secretary.

The Railroad Appliances & Electric Railway Supplies Exposition Company, Chicago, Ill., has been incorporated by P. H. Burg, R. H. Gray and Frank Longworth.

The Chicago Pneumatic Tool Company, Chicago, at the meeting of the board of directors, February 20, re-elected the retiring directors with the exception of J. W. Duntley, who is succeeded by J. H. Ward. Mr. Duntley has retired to engage in other business.

The Railway Steel-Spring Company, New York, at the recent meeting of the board of directors elected the following to membership on the board: H. K. Devereux, succeeding Julius E. French; George B. Motheral, succeeding Philo N. French, and Charles Scoot, Jr., succeeding George G. McMurtry.

The Ohio Seamless Tube Company, Shelby, Ohio, has increased its capital stock from $350,000 to $1,000,000.

The Rail Joint Company, New York, has moved its Chicago office from the Monadnock block to the Railway Exchange.

The Willard Storage Battery Co., Cleveland, Ohio, states that there are now in service over 100,000 Willard train-lighting cells.

The Cincinnati Car Company, Cincinnati, Ohio, has increased its capital from $100,000 to $1,500,000.

The Buckeye Mfg. Co., Alliance, Ohio, has increased its capital stock from $30,000 to $50,000, fully paid.

The Chicago Bearing Metal Company, Chicago, has increased its capital stock from $250,000 to $500,000.

The Canadian Car & Foundry Co., Ltd., has declared the regular quarterly dividend of 1 3-4 per cent. on its preferred stock, payable April 25 to stock of record March 31.

The Canadian Westinghouse Co., Ltd., has declared the usual quarterly dividend of 1½ per cent, payable April 10. Books close March 31 and reopen April 10.

The annual report of the Lackawanna Steel Company, New York, and subsidiaries, for the year ended December 31, 1910, shows gross sales of $31,302,760 as compared to $25,296,661 in 1909. The net income from manufacturing and operating was $6,330,470 in 1910, and $4,709,823 in 1909. The balance in 1910, after fixed charges was $2,533,105, or 7.25 per cent. on the capital stock, as compared with $778,109, or 2.2 per cent. on the capital stock, in 1909. Compared with 1907, the best previous year in the history of the corporation, the shipments show an increase of 9.15 per cent., and the balance after fixed charges shows an increase of $89,259, or 3.65 per cent., notwithstanding the fact that the average prices of 1910 were 4.36 per gross ton, or 13.1 per cent. less than those of 1907.

The Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has let contracts to the American Bridge Company, Pittsburgh, Pa., for 3,000 tons of structural steel to be used in building two new foundries at Trafford City. Work will be begun within a few weeks. The Westinghouse company has bought 30 acres near Trafford City, and it is planned to have all castings for the various Westinghouse companies produced at these foundries.

Dilworth, Porter & Co., Ltd., Pittsburg manufacturer of the Goldie claw tie plate, flat and flanged tie plates and track spikes of all sizes, is exhibiting in space No. 26 at the Coliseum. The Goldie tie plate is the oldest type of tie plate now in use and it maintains a deserved popularity over severe competition.

The American Car & Foundry Co. has declared the usual quarterly dividend of ½ of 1 per cent. on its common stock and 1¾ per cent. on its preferred stock, payable April 1 to stock of record March 10. Checks for both dividends will be mailed by the Guaranty Trust Co. of New York.

The properties of the Hicks Locomotive & Car Works, Chicago, consisting of the entire plants of the company at Chicago Heights, Ill., the good will and all the assets, were sold by William McInnes, trustee of the Hicks Locomotive & Car Works, in bankruptcy, to William Barbour of New York, on February 21. Mr. Barbour is president of the Linen Thread Company, New York, and a director of the Hanover National Bank. He and his associates have now effected an organization to be known as the Central Locomotive & Car Works, with office in the Fisher building, Chicago, which has succeeded to the business of the Hicks Locomotive & Car Works.

The Railway Storekeepers' Asso. will meet in its 8th annual convention at the Hotel Pfister, Milwaukee, Wis., May 22, 23, 24. The subjects are: "The Need for a Standard Material Classification and Disbursements in Order to Intelligently Compare the Work of the Various Supply Departments and the Relative Stock of Material Which They Maintain"; "The Railway as a Manufacturer"; "The Standardization of Tinware"; "The Standardization of Storehouses, Oil Houses, Scrap Docks, Supply Cars, etc"; "Timber Treating."

The Howett Manufacturing Co., St. Louis, Mo., has been incorporated to deal in railway equipment. The incorporators are Wilbur E. Howett, of St. Louis; George Barnett, of Webster Groves, Mo., and others. Capital stock, $10,000.

The Davis Lupton's Sons Company, Philadelphia, Pa., has opened an office in the Peoples Gas building, Chicago. This office will be in charge of R. A. Sanborn, who has resigned his position as division engineer for the board of supervising engineers of Chicago. Mr. Sanborn's experience in building construction will be an advantage to him in advising on the construction necessary in fitting Lupton products.

The Asbestos Protected Metal Company, Canton, Mass., has opened a branch office at 613 Fisher building, Chicago, under the management of Wilmot W. Burritt.

The Walls Frogless Switch & Manufacturing Company has been incorporated in Colorado to manufacture an invention of J. W. Walls, Pueblo, Colo. The incorporators are: J. W. Walls, M. C. Johnson and J. M. Luqueer.

Milton Bartley, president of the American Nut & Bolt Fastener Co., of Pittsburg, Pa., has just received patents granted him on January 17, 1911, for a new rail fastener. This fastener will be put on the market in the fall of this year, but any railway, we are advised, can have a trial lot without cost by giving the make of rail, size of bolt used and number of pounds of rail to the yard.

The Buffalo, Rochester & Pittsburg Ry. has placed an order with the General Railway Signal Co. for signal equipment for 35 miles of double track automatic signals, three position, upper quadrant.

Recent Engineering and Maintenance of Way Patents

RAILWAY TIE.

984,535—John A. Brooks, Clinton, Ind. Filed July 16, 1910. Serial No. 572,371.

This railway tie is composed of separate metallic side walls, interlocked and filled with concrete. The track is bolted to tie by means of plates, and bolts anchored in the concrete section.

RAIL JOINT.

984,546—William J. Diehl, Charlesville, Pa. Filed Dec. 14, 1909. Serial No. 533,079.

A two-piece rail joint with a reinforcing vertical part between the joint ties under the rails. The reinforcing rib is in two sections, one on each rail joint piece, and these ribs are bolted together, face to face, when the joint is installed in track.

CONCRETE RAILWAY TIE.

984,912—William H. Haslet, Pittsburg, Pa. Filed Sept. 21, 1910. Serial No. 583,021.

A concrete tie, provided with longitudinal reinforcing bars at top and bottom. One end of each longitudinal reinforcing bar turns up, and is bolted to the end of the opposite reinforcing bar. Rail receiving and retaining sockets are bolted through the body of the tie.

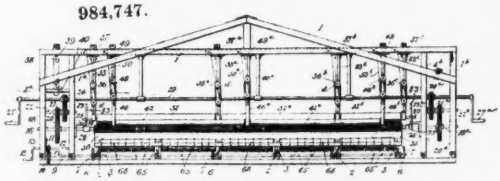
INSULATED RAIL JOINT.

985,092—Benjamin Wolhaupter, New York, N. Y., assignor to The Rail Joint Company, a corporation of New York. Filed June 18, 1907. Serial No. 379,548.

A four-piece insulated rail joint, consisting of a base plate, an angle bar for the inside of the rail, an insulating wood block, and a heavy outer plate with its angled top level with the top of the rail.

MACHINE FOR MAKING REINFORCED PILES, COLUMNS, ETC.

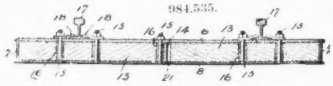
984,747.



984,747—Alexander Crawford Chenoweth, New York, N. Y., assignor of one-half to John McNamee, Brooklyn, N. Y. Filed Dec. 20, 1907. Serial No. 407,276.

This machine consists of a movable platform on which the reinforced material is rolled into a compact mass, and mechanism for rolling the body of material, and for winding a reinforcing wire around the exterior of the body.

984,535.



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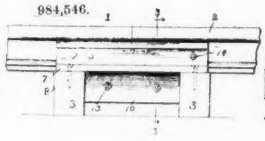

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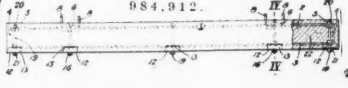

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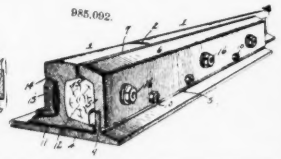

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